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OCTOBER, 1937

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INV. '60

The Farmer's Digest

From more than two hundred magazines and bulletins published in this country and abroad, the Editorial Staff of the Farmer's Digest selects articles of outstanding merit and general interest. It is comprehensive in its scope, covering all phases of Agriculture.

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The Farmer's Digest

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Better Farm Animals

Condensed from Popular Science Monthly

Sterling Gleason

IMAGINE a row of cross-eyed cows looking out from their stalls in a long dairy barn, peacefully chewing their cuds while experts feed them special rations planned by laboratory dietitians.

That is one of the strange sights you would see if you were to visit the University of California College of Agriculture at Davis, Calif., where scientists are striving to produce laboratory-bred, "standardized" animals so true to type that whole families will be as nearly alike as automobiles from a factory production line. They want cows that give milk generously; steers that produce finer, more tender beef; sheep heavily coated with superior wool; lambs built to make choice loins and chops; pigs that give firm, tasty bacons and hams well proportioned between fat and lean. In short, they want to cut the wastes caused by nature's mistakes and give us better foods for our tables at lower cost.

The weird-looking, cross-eyed cows are one set of answers to a problem upon which California scientists have been working for nearly twenty-five years. They represent a freak characteristic, known as a latent or "recessive" defect, long hidden in the blood of pedigreed animals and now for the first time intentionally brought to the surface so that it can be eliminated.

At the California experimental farm, Prof. William Regan has been deliberately inbreeding cattle, or mating sires with their daughters, in order to bring these latent defects to light, thus making it possible to weed out animals bearing defective strains, and to develop a superior, untainted stock. Queer specimens are produced by these experiments: cross-eyed cows, hairless calves, bow-legged animals, and hideous creatures with enormous heads and weird faces that resemble those of English bulldogs.

These mistakes of nature are

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ruthlessly discarded from the breeding stock, and, to the great satisfaction of the experimenters, the milk production of the test herd has been steadily rising. At the beginning, the average butter-fat production of the herd was 545 pounds a year; today it is 580 pounds.

Eventually, out of all these scores of animals will emerge one that passes all the tests, and a pure, faultless line can be started. This will stem from a super-cow —a blue-blooded animal which will give abundant milk, rate high as beef, and breed offspring that will have the same superior qualities.

Most interesting, perhaps, of all places in the huge California laboratories is the "psychrometric room," where cows and other animals undergo strange tests. In a small chamber, double - walled and heat - insulated, a cow is placed for observation, while the stall is regulated to any desired combination of temperature and humidity to give artificial climates ranging from that of a high mountain peak to that of the hottest desert. Air at a fixed temperature is supplied through a rubber nosepiece.

Every breath exhaled by the animal under test is collected by giant air pumps and drawn into apparatus where it is weighed and broken down into its constituents. Bubbles rise through long glass tubes full of liquid; batteries of narrow--stemmed flasks, filled with purple fluid, are rocked back and forth by mechanical hands; huge copper cylinders lazily rise and fall, in a mechanized chemical laboratory where almost every step in a long and tedious routine is performed automatically. An animal placed in the psychrometric chamber may have almost any bodily process measured, from the air it breathes to the efficiency of its digestive organs.

In one of the countless experiments made possible by this apparatus, the question was: Is a cow's rate of breathing controlled by the temperature of the air on her skin, or the temperature of the air reaching her lungs? By supplying the animal with cool air while the chamber itself was warm, and then reversing the situation, experimenters learned that the creature's skin acts as a sensitive indicator which controls the action of the lungs.

One of the most remarkable freaks at the laboratory is a cow equipped with a window in her side, left by an operation to remove an abnormal growth. Through a light-and-mirror device, almost anything that goes on inside the cow's body can be watched by the experts without pain to the animal. Farmers know, for instance, that too much green alfalfa will make a cow bloat up like a balloon. Once,

when this freak animal over-indulged in alfalfa, her digestive canal swelled up with gas; experimenters promptly hooked up apparatus and accurately measured the pressure, much as one tests a tire with an air gauge!

Problems of heredity are being studied by Dr. P. W. Gregory, who is striving to learn what governs the inheritance of size. Prof. R. F. Miller is working on long-time experiments to improve the quality of spring lambs by crossbreeding, while Prof. E. H. Hughes is seeking to "standardize" pig production by inbreeding hogs in the same way that Professor Regan is experimenting with cows.

Meanwhile, other experts at the University have been working to spread knowledge of their findings. Thirty-five prize bulls are out on loan to progressive farmers throughout the state, so that the blood of these superior animals may filter into the cow "population" and raise the standard of the whole. One California dairyman began eight years ago to bring the blood of these animals into his herd. Now, eighteen of his cows produce as much milk as thirty of those in his original group.

The work of the Davis "clinic" received spectacular demonstration when the latest census figures were released by the Government. A decade before, the average California cow was producing 182 pounds of butter fat a year—forty pounds more than the national average, but still not enough to make dairying a sound business.

At a dairy show that year, directors of the University's extension service announced that they were going to try, with the aid of farmers, to raise the California average to 265 pounds a year within ten years.

Through the following decade, the farm advisers went out into the field, urging farmers to join cow-testing associations, helping them to select better bulls and to weed out inferior ones. Scientific standards began to replace guesswork, and cows that did not measure up to them were gradually eliminated. Blood from purebred dairy bulls began to filter into the herds of the state.

By 1926, butter-fat production had shot to 225 pounds. More than 5,000 inferior cows had been discarded and 50,000 put under test. Enthusiasm mounted as rich milk poured in to swell profits. By 1930, 15,000 cows had been weeded out and 100,000 had been brought under regular scientific test. When the 1930 census figures were released, an amazing thing was discovered. Average butter - fat production for each cow had jumped to 265.6 pounds —six-tenths of a pound more than the goal set a decade before!

Not only at the University of California, but also at many other centers in the United States, scientists are delving into the secrets of breeding and raising superior livestock. At the U. S. Bureau of Animal Husbandry farm at Beltsville, Md., experts are tackling one of the oddest problems ever presented to agriculturists: How can we prevent hogs from getting sunburn? It seems that Danish pigs, introduced recently into the Middle West, proved very satisfactory, except for the fact that their tender skins blistered under the hot American sun. So experimenters are now striving to cross the blond Danish pigs with "English blacks," and so produce a strain of brunets that would be resistant to sunburn.

Draft horses are bred primarily for their pulling power. To test this factor, a special "horse dynamometer" devised by farm advisers was demonstrated recently. Mounted on the back of an auto truck, this apparatus consists of a number of disk-shaped lead weights which are attached to a harness by means of pulleys and steel cables. Teams of prize draft horses, straining their powerful muscles, tug at the harness to raise the disks vertically from the floor. By changing the number and size of the weights, experts can accurately gauge the maximum pulling power of the animals.

Foreign scientists also are working industriously to apply modern breeding principles to their own problems. Japanese experts are experimenting to produce strong, healthy horses that can withstand the rigorous Manchurian winters and still be small enough for the Japanese to ride comfortably.

Chinese farmers prefer heavy-horned cattle to horses for farm work, for such an animal cannot only plow but produce milk and meat as well. By crossing imported American short-horn bulls with the native cows, experimenters hope to produce an animal far superior to the Manchurian cow, now a small creature yielding only about three gallons of milk a day.

These are some of the phases of the world-wide efforts of science to untangle the snarled complexities of animal life.

Up from the Wild

Condensed from Country Gentleman

C. C. Harrington

IN 1910, Frederick V. Coville, chief botanist of the United States Department of Agriculture, published the results of his greenhouse experiments with blueberry plants. Although he pointed out the possibility of raising these bushes commercially, little did he dream that he was sowing the seeds of a farm industry that would be thoroughly commercialized in less than a man's lifetime.

Before he died, in January, 1937, Doctor Coville saw the establishment of bluberry plantations in over a dozen states—as widely spread as Maine, Washington and North Carolina. He saw his domesticated plants shipped as far as Europe, Japan and New Zealand. And he watched the blueberry crop of New Jersey alone climb to a yearly value of over a quarter of a million dollars, with North Carolina and Michigan not far behind.

The development work in back of the present blueberry plants was fascinating and difficult. The botanists were concerned with pollen and soil ingredients. Doctor Coville's greenhouse experiments showed that blueberry plants thrived best in a moist sandy soil that was rich in acid peat. He likewise proved that plants could be successfully raised from cuttings. This was very important, as it was this problem of propagation that had so long proved the stumbling block to those interested in domesticating the huckleberry. Even when they were able to transplant a few wild bushes that produced large berries, they were unable to grow other bushes from the original. Thirdly, Doctor Coville demonstrated that seedlings could be raised from crossed plants in order to improve the quality of the plant and produce good varieties.

But greenhouse experiments and field culture are remote, and in agriculture it is the field test that tells the story.

The real development of blueberry plants was done at the cranberry bogs of the Whites, in New Jersey. When the Department of Agriculture accepted the offer of Miss Elizabeth C. White to start field tests at Whitesbog, the transition from greenhouse to

Reprinted by permission from the Country Gentleman

field culture had begun. Miss White herself joined in the experimental work with an energy that cuts years from the trial period.

The combination of these two people working together was ideal for getting things done. On the one hand was Doctor Coville, a true botanist, endeavoring to produce bushes with perfect characteristics. On the other was Miss White, ever practical, and with her mind set on getting plants into commercial production.

The two New Hampshire bushes that Doctor Coville brought with him looked like too meager a beginning to Miss White. As there were no others available she set out to find some. To the native wild-huckleberry pickers in the Jersey pine country she gave metal plates with a five-eighth-inch hole drilled in one end, and a bottle of formaldehyde in which to put sample berries. What she wanted to find was bushes having berries large enough to cover the holes. And she got them.

Within six years she had collected more than a hundred bushes, each a sturdy specimen that produced gigantic berries. These were all wild bushes, and the better ones of the lot became the parent stock from which Doctor Coville made his thousands of crosses. They were the great-grandparents of practically all the present commercial blueberry varieties.

Doctor Coville's cold frames bristled with hybrids. The very best of these were transplanted in nursery rows. Later, the most promising in the nursery rows were set out in the field. Perhaps one or two varieties from every thousand seedlings would reach the field. Even this stage did not mark the final selection. Numerous cuttings were grown from each field bush to make certain that the propagated plants would have all the sterling qualities of the parent. The best of the plants meeting this final test were named and put into production.

Thus the plant factory began turning out bushes of commercial value—Rubel, Katherine, Pioneer, Cabot, Adams, and so forth. Many of these were soon superseded by better varieties. Others showed weaknesses that were not apparent in the experimental growing. But from the work there gradually flowed a series of sturdy varieties with excellent commercial qualities.

Each blueberry variety has its own characteristics. The Cabot and June are the early fruiters and therefore hit the market when the price is high. On the debit side, each of these varieties is hard to propagate. One of the most reliable main-crop varieties is the Rubel. This variety is not a hybrid at all, but is one of the

first wild bushes selected by Miss White. Its success has been so outstanding that nearly 50 per cent of the present plantings are in Rubels, and 90 per cent of the popular hybrids have Rubel in their strain. The Jersey, for instance, resulted from a cross between a Rubel and a Grove. Although the Rubel is easy to propagate, its berries are slightly sour. The Pioneer, Rancocas and Jersey are main-crop bushes much favored by growers. On the horizon, however, are still newer varieties, like the Weymouth and Dixie, which may put the lusty pioneers to shame.

To start his plantation, the blueberry grower must buy bushes of established varieties. Unless he is very foolish he does this only after he is certain that his soil is suitable for the growing of blueberry bushes. And these plants are most fastidious, demanding a sandy soil rich in peat and with an acidity ranging, for best results, from pH 4.5 to pH 5.0.

New bushes cost from fifty cents up, depending on the size and variety. They are set out about four feet apart in rows eight feet apart. For the best results, blueberries must be thoroughly cross-pollinated. Thus the grower plants alternate rows of at least two different varieties.

The biggest bugaboo to the grower is propagation. At the present stage of development, the industry cannot supply a sufficient quantity of bushes at a low enough price to permit extensive plantations. When the grower wishes to expand he must raise bushes by means of cuttings from his own plants. And even in its present highly developed stage, this is no easy task.

Hardwood cuttings are the principal sources of new plants. They are usually obtained at the time of pruning, in the late winter. Wood from the previous season's growth is cut in four-inch lengths, each twig bearing several leaf buds. Cuttings were formerly grown in well-drained cold frames, where it was necessary to continually adjust the glass sashes and shades, depending on the temperature of the air and the brightness of the sun. To simplify this procedure, Miss White has developed the lath house, which, although it requires more watering, eliminates the constant adjustment of shade and ventilation. The lath house is a six-foot-tall structure enclosed on the sides and top by lathing spaced about one inch apart. The beds in this structure are filled with a carefully prepared mixture of well-rotted peat and sand.

By the end of June the cuttings should be well rooted and starting their second growth. They are kept in the lath house until the following spring, at which

time they are set out in nursery rows. Here the plants develop quickly and after one year are ready to be transplanted in the field. The field bushes then take from two to three years before they start producing in commercial quantities. They reach their peak of production after five years in the field.

As the interest in blueberry culture has spread and the plant has proved its commercial possibilities, various state departments of agriculture have set up their own experimenting stations. These places are rapidly adding to the fund of knowledge that eases the growing pains of this infant industry.

A proper balance between leaf area and fruit is essential if a large crop of high-grade berries is desired. This requires that the bushes be cut back drastically each year. Even today, when pruning requirements are definitely known, the art of trimming a blueberry bush demands a skill that is acquired only after years of experience. Probably the greatest single fault that new growers have is their reluctance to properly cut back the new bushes.

The commercial success of blueberry growing depends to a large extent upon proper fertilizing. Actual results were shown by tests made by Charles S. Beckwith at the New Jersey Station and at Whitesbog. He based his fertilizer experiments on the methods in successful use with cranberries, as the similarity of the soils justified. His results proved that by applying the proper fertilizer at the most effective time, the yield of blueberries will be double and often triple that of the unfertilized bushes. The fertilizer now recommended to the Jersey growers by the New Jersey Station is made up as follows: 450 pounds of nitrate of soda, 450 pounds of calcium nitrate, 800 pounds of rock phosphate, 300 pounds of sulphate of potash.

Co-operating with New Jersey growers, the Experiment Station has also demonstrated the value of the autogiro and airplane as an insecticide-spreading medium. A few years ago the blueberry fruit fly struck the New Jersey plantations, promising extensive damage unless immediately checked. The nature of this insect, which attacks the maturing fruit, necessitates spreading the insecticide as rapidly as possible during the brief period in which the pest is most numerous. Dust that is applied too far ahead of time will be rendered totally ineffective by the first heavy rain. The air machine, however, permeates a large area with the dust at a speed that permits combating the insect at the most effective moment.

The Michigan Experiment Sta-

tions have done considerable work on propagation, with an eye toward mitigating this problem of the growers. Both the Michigan Station and the U. S. D. A. Stations in North Carolina are making extensive tests to develop new varieties that will be better suited to local conditions.

Ninety-five per cent of the New Jersey and North Carolina blueberry crop is marketed by the Blueberry Co-operative Association. This co-operative organization handles all general fruit advertising and establishes definite requirements as to grade and quality. Blueberries were the first fruit to be packed and sold under Cellophane.

Although most present blueberry plantations are located in lowland sections where there is a suitable acid soil, recent experiments indicate that other types of land can be made suitable for blueberry culture. At the State Horticulture Farm, in New Brunswick, New Jersey, a permanent mulch has been successfully used to raise several varieties of these berries in upland loam soil. The mulch used was mostly salt hay, although Sudan grass, leaves and rye straw have been added with equal success. The soil ranged in acidity from pH 5.0 to pH 5.5. Among the most successful of the varieties planted were the Adams, Jersey, Cabot and Rancocas.

The present trend of the blueberry industry is toward a hardy boom. As fast as plants become available new growers are setting out plantations and established growers are expanding their fields. Lowland areas, long considered useless, are being cleared and planted with this fruit. North Carolina is particularly popular, because there the berries ripen early and reach the market while the prices are high.

The size and uniformly excellent quality of the cultivated fruit assure it a permanent market demand in preference to the wild berries. Yet in spite of the success of the modern varieties, the United States Department of Agriculture and Miss White are continuously working to develop new and better hybrids. It was less than three decades ago that Doctor Coville's blueberry work was first published. In this short period a few greenhouse experiments have blossomed into a full-fledged agricultural activity. A completely wild plant has been domesticated and improved until it has proved a commercial success—all in less than a man's lifetime.

Cost of Tractor Operation

Condensed from New Jersey Agriculture

John W. Carncross

Assistant Agricultural Economist, N. J. Exp. Station

THE average cost of operating 50 tractors for the year on fruit and vegetable farms in Burlington and Monmouth Counties, New Jersey, was $308.73. They were used an average of 492 hours in the year, making a cost of 63 cents per hour worked. Included among them were the four-wheel or plow type, the track-laying or crawling type, and the general purpose or cultivating type.

The cost for 947 gallons of gasoline was $102.02 per tractor for the year. This made a cost for this largest single item of expense of 21 cents per hour, or one-third of the total cost. An average of 1.93 gallons of gasoline was used for each hour the tractor was worked.

The average charge for depreciation was $95.31 a tractor for the year, or 19 cents an hour of use, and repairs amounted to $48.85 for the year, or 10 cents per hour. Thus these three items of gasoline, depreciation, and repairs accounted for 80 per cent of the total cost of tractor operation. The average original cost of these tractors was $926 and it was estimated by the owners that their average life would be 9.8 years.

There were 28 tractors on 23 farms surveyed in Burlington County, and for this group the average cost of operation for the year was $322. The tractors were worked an average of 530 hours, making a cost of 61 cents per hour worked. The original cost was $927. In Monmouth County there were 22 tractors on the 18 farms included in the survey and their average annual cost was $292. They were worked an average of 443 hours, making a cost of 66 cents an hour used. The original cost per tractor in this group was $924.

The largest single enterprise on these farms was apple production, there being an average of 37 acres of bearing apple orchard per farm. For the average of the 50 tractors, 262 of the 492 total hours of annual use or 53 per cent was for work on the apple orchard. The principal operations for which the tractor was used in the apple orchard was for spray-

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ing, which accounted for 54 per cent of the total tractor use on the orchard, and for cultivating, which accounted for 34 per cent of the total hours of tractor use on the apple orchard.

The greatest single factor affecting the cost for operating a tractor for hour of work done was the total hours the tractor was used for the year. The cost for the hour of work done by the tractor ranged from a low of 34 cents on one farm which used the tractor an average of 1,300 hours a year, to a high of $1.88 on another farm where the tractor was used only 230 hours for the year. Thirty-two of the 50 tractors, or approximately two-thirds of the total, were operated within the cost range of between 40 and 80 cents an hour. Only four tractors had an average cost per hour of less than 40 cents, while 14 had costs of more than 80 cents. These 14 tractors which had a cost per hour of more than 80 cents averaged 289 hours of work for the year. This relationship of the hours the tractor was used per year to the cost for the hour used, is illustrated in the accompanying table.

It will be noted that the lowest range group, those in which the tractor worked less than 200 hours during the year, or an average of 140 hours, had a total cost for the tractor for the year of $159, or $1.14 for the hour worked. The group of farms with an annual use per tractor of 801 hours or more and averaging 1,043 hours, had an average total cost for the tractor for the year of $476.46 per hour or 46 cents for the hour worked.

(Table gives) **Average Cost Per Tractor**

Item of Expense	For Year	Per Hour Used	% of Total
Gasoline, 947 gallons	$102.02	$ .21	33
Depreciation	95.31	.19	31
Repairs	48.85	.10	16
Interest	27.78	.06	9
Oil, 82 quarts	11.22	.02	3
Grease, Servicing, Housing, Etc.	23.55	.05	8
Total	$308.73	$ .63	100

Hours used per year—492

(also) **Relation of Hours Tractor Was Used Per Year and Cost for the Hour**

Hours Worked Per Year Group Range	Average	Annual Cost of Tractor	Cost Per Hour Used	No. of Tractors
200 hours and less	140	$159	$1.14	6
201-400 hours	294	244	.83	15
401-600 hours	498	326	.66	17
601-800 hours	714	388	.54	5
801 and over	1043	476	.46	7

Control of Fowl Pox

Condensed from American Poultry Journal

Dr. Cliff D. Carpenter

FOWL pox is one of the deadliest enemies of the poultry and turkey business. Striking, as it usually does, when the pullets are in full production, or when turkeys are half grown, it gets off to a slow but sure start, and before you know it, a third of the flock is visibly infected; and your year's profits are in the balance.

Fowl pox is known by many names. Called contagiosa epithelioma by the scientists, meaning contagious tumor of the skin or epithelium, it is best known as fowl pox, or chicken pox. Sorehead and canker are often used to designate the infection. The terms "swelled head" and "diphtheritic roup" are incorrectly applied.

Every disease has a causative agent. Many are produced by germs invisible to the eye, but clearly distinguished with the microscope. Others are so small that even the most powerful microscope cannot enlarge them sufficiently to see them. We call these "viruses," and because they pass through porcelain-like filters, we call them "filtrable viruses."

Fowl pox is a filtrable virus disease.

It is a wound infection, that enters a small break in the skin or mucous membrane. Many believe that the disease starts internally, affecting the blood and body organs, and that it "breaks out," much in the same manner as a skin rash, or boils in humans. This is definitely not so, for it neither attacks, nor lives in the blood stream, nor in any internal organ.

Experimentally, the blood from a badly infected chicken may be inoculated directly into a susceptible, unvaccinated pullet, and not produce the disease in any form.

Usually the disease is first seen on the comb or wattles, although it may appear on any part of the body. Feathers provide a natural protection to most of the body and so the bare skin around the head provides the most vulnerable spot. If fowl pox attacks a flock while they are molting, pox tumors may be found all over the body.

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The virus, once it enters, finds a natural incubator in the cells of the skin, and in a few days, new and pathologic cells are produced in great quantity; after about 4 days, we first see a small, almost blister-like swelling, nearly straw colored, which gradually turns brown and then almost black. The surface is raised and rough, like a wart.

In the absence of treatment, this individual scab drops off in 2 to 4 weeks and the bird recovers, provided this is the only point infected and the location of the scab did not interfere with the mouth or eyes. Once successfully through the disease, the bird remains immune to later attacks for life. Successful vaccination is based on this fact.

Seldom, however, is the disease limited to a single scab, since close contact with other birds in the flock may infect a half dozen spots even within a day's time. Then, too, the virus may enter or spread to the membrane that lines the eye and the mouth, even extending to the larynx, or opening of the trachea. Since the structure of these mucous surfaces is different from the skin, the result is different, and in a few days a thick yellow canker or diphtheritic membrance is seen, which gives rise to the term "diphtheria."

Heavy, lopped comb breeds such as Leghorns may have a large number of comb scabs. Males almost always have a heavy infection of both the wattles and comb—from fighting and dragging the wattles over infected feed hoppers and drinking containers.

If birds reach for their food through wooden slats or wire grills, a large number of eye cases results.

All cankers, however, are not caused by fowl pox virus. Any injury to the lining of the mouth heals by filling in the area with a cankerous material which superficially looks like fowl pox canker. So a diagnosis of fowl pox is never made unless some birds in the flock show the external or scab form of the disease.

Turkeys are equally susceptible to the disease, and because so much of the head and neck are unprotected by feathers, the resulting loss of flesh and mortality may be higher than with chickens.

A similar disease is pigeon pox in pigeons.

Wild birds, particularly sparrows, contact and spread fowl pox. Birds travel great distances and provide a definite means of spread. Mosquitoes, infected coops and utensils add to the dangers in unprotected flocks.

There is no medicine nor magic to shorten the course of the disease once it attacks a chicken or turkey. Nor is there any known

method of preventing its appearance except to vaccinate.

While the disease has appeared in every state, there are some sections where whole counties have not experienced it. Not to vaccinate young pullets on a farm where fowl pox has appeared once is to invite disaster, but there is no reason to vaccinate any flock of pullets if the disease has never made its appearance in the community or county.

The first year that a live virus was available, about one-half million doses were produced in this country under the supervision of the United States Department of Agriculture. The amount was doubled each of the next four years, and by the fifth year, more than 7½ million doses were produced; 1936 saw this figure jump to over 17 million including that used for both chickens and turkeys.

Vaccination consists of breaking the skin surface at some point, far enough away from the head to avoid complications. When the skin has been broken, we introduce the virus (vaccine), thus infecting that spot with fowl pox. In other words, we give each bird a mild dose of fowl pox, and in 3 to 4 weeks, exposure to the most virulent type of the disease will be harmless.

Growing pullets, in good health, show but little reaction to this operation—6 to 12 weeks being the ideal age. Care must be exercised to see that they are in good flesh, when vaccinated, and free from colds and coccidiosis.

There are two satisfactory methods of applying fowl pox vaccine. One is the feather follicle, or "brush" method, in which 3 feathers (only 2 in turkeys) are removed from the region of the thigh or drumstick. A short stiff brush is dipped into the vaccine and applied rather vigorously to the open follicles.

The other is called the "stick" or "stab" method, in which one or more sharp points pierce the skin of the leg or web of the wing, at the same time carrying with it some of the vaccine into which the instrument is dipped just prior to "sticking."

An infection of fowl pox may appear suddenly for the first time in a locality. If this occurs in a laying flock, the balance of the flock should be vaccinated immediately *not* with chicken strain, fowl pox vaccine, but pigeon strain fowl pox vaccine.

This recently improved product of correct strain, properly applied, will protect uninfected layers for several months, usually until the heavy laying is over. Or it may cause the infection to be so mild as to keep egg production about normal. Such a flock if vaccinated with *chicken* strain fowl pox vaccine would drop in

egg production, and, depending on weather conditions, might even be thrown into a molt.

Pigeon strain fowl pox vaccine is used in large quantities today to provide protection for a few weeks without interfering with food consumption or slowing up growth in broiler plants. However, the "stick" method cannot be used successfully in applying pigeon strain fowl pox vaccine, since the amount of protection afforded against the disease is dependent entirely upon the area vaccinated, or the size of the "take." At least 10, preferably 15, feather follicles should be inoculated by the "brush" method for satisfactory results.

Fowl pox, allowed to run its course in a flock of laying pullets, produces a loss of $30.00 to $70.00 per hundred birds. Consequently the progress in combatting this disease not only reflects great credit upon world-famous poultry disease investigators—Beach, Johnson, de Blieck and Van Heelsbergen—but also prevents the loss of millions of dollars to the world's greatest agricultural industry.

Oats

Condensed from Successful Farming

T. R. Stanton

U. S. Bureau of Plant Industry

OATS occupy an unusual position among the crops of the land. Not only do they nourish the farmer and his family and their stock; they form a necessary link to nourish farm acres as well. And there, in the face of criticism that oats-growing is sometimes unprofitable, is a triple play hard to beat.

In order to get weary land back to grass and a rest, the American farmer keeps right on growing oats to the tune of 40,000,000 bushels annually—a case of "you can't get along *with* 'em, and you can't get along *without* 'em." But today's plant-breeders have an answer: "Make the crop more profitable"—and that's what they have done and are doing for your benefit.

Just where oats originated and when first grown as a domestic crop is not definitely known. The common oat that is grown in the

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Upper Mississippi Valley today evidently was first cultivated by the ancient Slavs who peopled Western Europe during the Iron and Bronze ages. From here it was carried westward with the vanguard of civilization. Definite historical information on crop oats begins with the early Christian Era.

Oats have been grown on the North American continent since the settlement of the earliest colonies on the Atlantic seaboard. Oat production, however, did not attain great economic importance in the United States until the colonization and development of the Upper Mississippi Valley. In this region the early culture of oats was not satisfactory, primarily because of poorly adapted and inferior varieties. There was a need for varieties that would produce oats of higher quality on the newly broken, rich, black prairie soils. Up until nearly the beginning of the present century the available varieties were too late in ripening, possessed weak straw, lodged badly, and were very susceptible to rusts and smuts.

In the late nineties of the past century a new interest in plant breeding developed, following the rediscovery of Mendel's law of inheritance. As a consequence, plant-explorers were dispatched to Europe and other continents to collect and introduce plant material that might serve as foundation stocks for improvement by selection and possibly by hybridization. F. W. Taylor, of the Nebraska Agricultural Experiment Station, and the late M. A. Carleton, of the United States Department of Agriculture, introduced almost simultaneously similar varieties, Kherson and Sixty-Day, from Russia in 1896 and 1899, respectively. The introduction of these early, high-yielding, disease- and drought-escaping varieties marked the beginning of an epoch in oat improvement in the United States. After growing them a few years it was observed that they were made up of several types; that is, they contained strains varying in height, color, disease resistance, and productivity. Thus the great potential value of the Kherson and Sixty-Day varieties for improvement by selection was discovered.

No other young breeder in the Cornbelt was more alive to this opportunity than L. C. Burnett, of the Iowa experiment station staff and the United States Department of Agriculture, who today ranks at the top as one of the most successful breeders of the improved oats in the United States. By careful and intelligent selection from thousands of plant or progeny rows—oats grown from a single head or panicle in a short (3- to 5-foot) nursery row—he was able to isolate

strains under the environment of Ames, Iowa, that had stiff straw and high resistance to stem rust and produced more and better grain per acre. Among the improved varieties developed by Burnett as selections from Kherson or Sixty-Day are Richland (Iowa No. 105), Iogold, Iowar, and Albion (Iowa No. 103). The first two are especially noteworthy because of high resistance to stem rust, one of the most destructive diseases attacking oats in the Midwest. They also are being used extensively as parental material in current oat-breeding programs for the transfer by hybridization of stem-rust resistance to other varietal types. Iogren, originating as a selection from Green Russian, and Iowa No. 444 are additional Burnett varieties.

Oat-breeders in other Cornbelt states have made selections from Kherson and Sixty-Day that also are of much economic value. Among these, named in their probable rank of importance, are Gopher, State Pride, Nebraska No. 21, and Cole, developed by the agricultural experiment stations of Minnesota, Wisconsin, Nebraska, and South Dakota, respectively. Columbia, an improved variety developed by W. C. Etheridge and co-workers at the Missouri Agricultural Experiment Station, is an example of improvement by selection which has an especial value to the lower Mississippi Valley grain-growing area. Anthony and Minrus, improved midseason, stem-rust-resistant varieties, developed by H. K. Hayes and associates at the Minnesota Agricultural Experiment Station, are noted examples of improving oats by hybridization and subsequent selection. Rainbow and Rusota are valuable improved varieties that were selected from the Green Russian variety and developed by the North Dakota Agricultural Experiment Station for growing in the Red River Valley of North Dakota and Minnesota. Wayne, a new hybrid variety developed by the Ohio Agricultural Experiment Station, is the leading variety for northern Ohio.

A recent outstanding accomplishment in oat breeding is the development of new strains—the economic value of which yet remains to be determined—that are resistant to smut, crown rust, and stem rust. These strains are achieved by crossing varieties such as Richland and Iogold on the smut- and crown-rust-resistant Victoria variety, introduced from South America as recently as 1927 by the United States Department of Agriculture. Similar disease-resistant selections also have been obtained by crossing on Bond, a crown-rust-resistant hybrid oat, introduced from Australia in 1929 by

the United States Department of Agriculture. These latter most promising selections have been effected in breeding experiments at the Iowa Agricultural Experiment Station in co-operation with the United States Department of Agriculture.

In the Cornbelt, as in almost any other section, the goals of oat breeding today are higher yield; resistance to disease, lodging, and shattering; and better quality. In the South, the problem of breeding for resistance to cold is most pertinent. Much more genetic and plant-breeding effort should be given to this problem. Varieties should be bred that will make winter oats a more certain crop in sections where they are now grown. Furthermore, the development of hardier sorts will serve to advance the winter oat belt northward. Varieties 20 percent more cold resistant than any now available would be of great economic value. At present an attempt is being made to collect closely allied perennial grasses (species) of the genus to which oats belong for use in future hybridization experiments. The field of interspecific crossing is a new one and one that is fraught with great possibilities.

It is not a difficult job to select heads or panicles from a field of oats, particularly those which appear to be better than average, and also those that may be different, and then to sow the seed from each in a head or progeny row. At harvest only the best head rows are saved for future propagation and testing. Ability to discard the many inferior progenies and to save the few superior ones is essential for success. Any of the best lines saved may represent a potential new agricultural variety of oats. Breeding by hybridization is a more technical and difficult method and should be left to those who have had training in genetics.

An excellent example of oat improvement by simple methods is the devolopment of Fulghum, a red oat now grown extensively in the southern half of the United States. The late J. A. Fulghum, a progressive and enterprising farmer of Warrenton, Georgia, some years ago was walking through his field of Red Rustproof (Red Texas) oats one Sunday morning admiring this crop and estimating the probable acre yield, when he spied a plant that was really different from those surrounding it; that is, it was taller and produced smaller grain with fewer awns or beards. He harvested this plant separately and multiplied the seed from it. The new oat was so promising that seed was sold to other farmers and it soon became popular, especially for fall sowing in the southeastern states,

whence it later spread westward into Missouri, Kansas, Oklahoma, Texas, and California. In these states Fulghum has become the leading spring-sown variety. Thus, from this one unusual-looking plant first observed by a keen-eyed Georgia farmer, about 5,000,000 acres of Fulghum and its strains, such as Kanota, Frazier, Franklin, and so on, are grown today. Fulghum probably occurred as a natural hybrid in Red Rustproof.

A splendid example of oat improvement through careful selection, that is, simply by looking over many panicles and choosing only those in which the grains conform to a certain type, is the work of Gustav Kaswarm, of Salt Lake County, Utah. Some years ago he purchased some Swedish Select Oats for seed. This seed produced plants that were not uniform in certain kernel characters and thus did not meet the requirements of the critical eye of Mr. Kaswarm, who is said to be the best farmer in Utah and one who produces high-grade, pure seed of wheat, oats, and barley. The strain of mid-season white oats developed and grown by Mr. Kaswarm from his first Swedish Select is one of the most uniform of this type that has come to the writer's attention. As a matter of fact, it doubtless represents a slight variation from Swedish Select that has been highly purified and selected to a definite type. Kaswarm's years of experience and natural aptitude for plant breeding enable him to discern "rogues" or off-type plants in fields that would escape the eye of many with much more technical training in genetics and plant breeding.

A wealth of superior plant material in oats, consisting of many improved and economically important varieties and hundreds of superior strains resulting from current breeding programs, is now available as foundation or basic stocks for use in future oat breeding. A catalog of the material available in the United States and Canada and for almost all other important oat-producing countries, has been published recently by the United States Department of Agriculture.

The outlook for future advances is better at present than at any other time in the history of oat improvement.

The Goal of Crop Insurance

Condensed from Nation's Business

A. G. Black

Chief of the Bureau of Agricultural Economics

THE general idea of crop insurance is not new. It has been before the public in one form or another for 30 years. Scarcely a Congress in recent years but has considered some proposals for crop insurance legislation.

Private companies have entered the field of crop insurance at least four times since 1899. All these ventures may be termed failures. The reasons for those failures are fairly well-known.

In the first place, the insurance was put into effect in rather restricted areas which left it open to the hazard of local crop failure.

In the second place, the companies attempted to take on the job of insuring the farmer's income rather than merely his losses of crop. That is to say, they assumed the hazard of a decline in price as well as of failure of the crop itself.

In the third place, there is reasonable doubt as to whether the companies had enough data to build their insurance programs on a safe actuarial basis. They were working in an experimental field with little to help them estimate risks and premiums.

The AAA, in its programs of the past three years, has collected a body of data on individual yields, production and acreage such as never has been available anywhere before. This is true especially of wheat farms. We have never before had so good a basis as we now have for estimates of crop losses and necessary premiums.

When the pressure arising from drought and misfortune in the wheat regions had led up to serious consideration of crop insurance, the President last fall appointed a committee to study this whole subject and report to him upon the advisability of legislation.

This committee tried to dig into the question in such a way that its recommendations should take reasonable account of all of the realities in the situation. It called in the representatives of the old line insurance companies, who told us frankly of the limitations which any private company would be up against in undertaking a program of all-risk

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insurance. They expressed the opinion that no agency short of the federal Government could tackle the problem with reasonable hope of success. The case was likened somewhat to that of bank deposit insurance. The failures of the private companies were freely discussed.

Those studying this question previously had leaned toward a system of insurance with payments "in kind." Any such system would, of course, involve a large problem of storage of the premium payments and reserves. The President's committee, therefore, called in representatives of private warehouse and commission interests and put the matter up to them. These gentlemen assured the committee that ample storage space would be available, that they were in position to offer the Government all the storage space it would need at low rates.

Our committee, after extensixe consideration of the matter, felt that the possibilities were sufficient to warrant an experiment in crop insurance. We recommended to the President that the start be made with one crop only. Wheat was chosen because of the need for it, because wheat is reasonably well adapted to come under such a system, and because wheat growers were foremost in urging it.

Under the proposed plan, the crop insurance will be entirely optional, although under some of the new insurance systems in Europe it is made compulsory. It will almost necessarily have to be tied up with co-operation in the Soil Conservation Program, and will, therefore, become a sort of auxiliary to the general agricultural program.

The expectation is that the wheat grower will be insured against loss up to a certain percentage—say 75 per cent—of his yield. For example, if the average yield of wheat on a given farm is 16 bushels to the acre, insurance might be offered to cover 75 per cent of this, or 12 bushels. Thus, if that grower failed to get 12 bushels to the acre he would be indemnified up to that yield, but if he produced 12 bushels or more he would get no indemnification. His premium payments would have been figured accordingly.

It is not intended to assure the farmer any fixed money return on his crop. As already noted, that would involve taking on the hazard of price as well as of yields.

Payment in kind would appear to be one short-cut across this question of price hazard. If the farmer pays his premium in wheat and receives loss payments in wheat the element of price fluctuation has not entered into the equation. As a practical proposition it would not always

be feasible to make these payments in kind, and in those cases actual transfer might be made, not in the physical commodity but in its dollar equivalent.

It is no part of the intention to insure farmers against poor farming, to over-insure the low yield man, nor to penalize the farm that has high yields on the average. The idea is, in the first place, to under-insure somewhat.

In the second place, the idea is to base premium rates chiefly upon the average loss experience on each individual farm. The variation in a grower's yields over a period of years thus becomes the main determining element in the rate which he will have to pay for the insurance. The probability is that the average yields for the county or some wider regional unit will be used as an adjusting or modifying factor along with the yield experience on the individual farm. Thus, in fact, the premium rate on a given farm will be based largely upon that farm's own yield experience, but partly also upon the wider experience of that region.

Consideration of all of these factors will bring the costs and benefits of the insurance down to a direct relationship to each individual farm. It will be a fair break for the individual whether he is a good farmer in a good region or otherwise. I might add that this proposal to base premium rates upon the loss experience of individual farms has been discussed with both insurance men and wheat growers, and has been well received by both.

Presumably with some such system of payment in kind, the grower would pay his premium by delivering wheat to a local elevator which had been designated to receive it. It might be stored there or shipped elsewhere for storage. As payment in kind might not always be practicable, provision will have to be made for payment in cash equivalent. In any event, the insurance agency would receive wheat or would convert the cash payment into wheat for storage. Under this system, the insurance reserves always would be stored in the form of wheat.

The payment of losses could be handled in various ways. The farmer might be paid in grain if he wished, or he might be paid its cash equivalent, or possibly he might be given a certificate of ownership which would empower him to dispose of his grain from the central reserves as he saw fit.

Such a system of crop insurance might have a stabilizing effect upon the markets. It is conceivable that this might prove to be an important incidental outcome.

Someone will point out that the Farm Board tried something of this kind without profit to any-

one. This insurance proposal, however, would differ from the Farm Board experiment. There would be no attempt at price fixing. No governmental agency would be in the market buying and selling grain at pegged prices. In years of heavy crops, premium payments would flow into the central reserves and would be carried along in storage definitely earmarked to a specific use—the payment of losses. This grain would not overhang the market as a bearish factor. It would flow out of storage automatically in the year of crop failure and would come on the market at current prices. It is conceivable that, if these reserves were large enough, the system would act as a definite stabilizer in respect to both market supply and price.

This proposal hardly comes in the category of loosely socialistic enterprises which some have inferred it to be. The intent is that farmers will pay for their own insurance. The Government's part will be to provide the overhead, administrative machinery necessary to launch the system experimentally.

The public stake in the experiment will not have been a large one, should it fail; on the other hand, the public stands to gain a great deal should it succeed.

Nor is this a case of governmental interference within the field of private business.

So far as the President's committee could discover, the private insurance companies feel that, at present, all-risk crop insurance is beyond their normal scope.

It is the kind of job that seems to require a governmental set-up. The old-line companies have offered every co-operation in furthering the undertaking.

As to the principle of the insurance itself, there can be no doubt that business men endorse it. Such men employ the insurance principle to cover virtually every hazard of business. Wheat, for example, is covered by insurance from the moment it lands in a country elevator until it goes into the housewife's kitchen as a sack of flour. All the way through the distributive system wheat is insured. Now the proposal is to work out some feasible plan by which the grain also can be covered by insurance back there on the production end.

It does not seem unreasonable to expect that banks, insurance companies and other institutions extending farm credit will look on crop insurance as a valuable thing.

A system of this kind certainly would play a large part in helping a farmer to maintain his credit status after a year of crop failure and put him in position to be a favorable credit risk for subsequent borrowing.

Salt Water Cure for Horses

Condensed from The Horse

Charles Longstreth McNichols

Harry Unna's salt water cure for foot and leg ailments has been a live topic of conversation in racing and breeding circles on the West Coast for some time. Mr Unna, believes that he can cure anything from quarter-cracks to the starting-gate jitters by judicious application of those sovereign remedies he calls the three "S's" —Sea, Sun, and Sand. He first tried this treatment on his own horses with astonishing results and lately he has been prevailed upon by other owners to put their animals through it.

There is no mystery about the cure. Mr. Unna has no patent on it and fully explains it to interested persons with all the fervor of a true enthusiast. In his own words:

"There is an elasticity to the sandy beach that develops legs of iron. When a horse puts his hoof down, the sand breaks away and gives. This is in direct contrast to a step on the hard, unyielding surface of the race track. Later, when the horses become accustomed to the ocean, they are taken for gallops, at low tide, in the water. This allows the salt water to splash over their legs and under their bodies. At the same time their lungs are inhaling the salt breezes and their chests fill out. They are taken as far out in the surf as they can go without being swept off their feet, then instead of being returned to a stall, they are rubbed down and put in spacious outdoor corrals."

The first step in the treatment of any animal usually consists in leading him down onto the beach, preferably at low tide, and as far out into the surf as he willingly will go. There he stands as long as he will while the waves surge back and forth over his feet and around his legs. The theory is that the salt and sand-laden water swirling around the horses' legs acts both as a cold pack and a gentle massage, and that furthermore the salts, sodium chloride, and sodium and potassium bromide and iodine have a pronounced medicinal effect.

Nervous animals are never forced to enter the water. Time

Reprinted by permission from The Horse

and patience are necessary to get such horses accustomed to the surf, but in due course all of them take to it readily and head right out into the waves, and willingly stand braced against the force of the combers when the crests strike belly-high. Once they are used to it, many horses show considerable reluctance about leaving the water.

About a mile and a quarter north of the main stables is a five-eights mile track on soft, red, sandy loam soil, directly back of the beach. When leg swelling and actual lameness have been eradicated, the horse is walked or galloped up the beach along the edge of the surf and put around the track one to four times, according to condition and training requirements. This is done twice a day. After these works the horse comes splashing home through the surf.

The sunshine and sea air are good for a horse whether there is anything the matter with him or not. His gallop on the sand makes him get a lot of good salt air into his lungs. That's a tonic. He walks through the salt water and strengthens his legs and hoofs. Makes his feet ready to stand the hard pounding on the track.

Successful Results from Artificial Fecundation

ARGENTINA has obtained its first successful results from artificial fecundation of cattle using seminal fluid brought from the United States. The fluid was transported over 8,000 miles, by airplane, railroad and automobile.

A heifer calf has just been born at the estancia "La Merced" in the Province of Buenos Aires and it is believed that this opens up enormous possibilities for the improvement of cattle strains, particularly in the tick zones of Entre Rios. It will now be possible to fecundate cows with the semen of the best bulls whose capacity can be increased from 60 to 500 females.

In this particular case the liquid was extracted Sept. 19 last in the United States and carried at a special temperature by air express to Buenos Aires where it arrived on Sept. 25. The artificial fecundation was effected under the supervision of Department of Agriculture officials. Six other cows treated in the same manner are expected to calve shortly.

—American Hereford Journal

Protein Requirements of the Pig

Condensed from Penn State Farmer

T. B. Keith

THE protein nutrient of livestock rations demands more consideration than the other nutrients because of its complexity and the scarcity of the source of protein in farm-grown feeds.

It is an established fact that pigs, of all farm animals, are most likely to suffer from deficient rations. This is due to two principal causes. In the first place, pigs are fed largely on grain and get relatively little roughage, especially when they are fed under conditions of close housing. In the second place, they grow more rapidly than other farm animals in relation to their birth weight, with the result that their requirements for essential dietary constituents are more exacting.

The importance of protein in the diet, both in human nutrition and in animal nutrition, is being increasingly recognized. Although the protein content of feed is usually estimated on the basis of its nitrogen percentage, the values thus obtained do not constitute fair criteria by which the protein nutritional value of a feed may be determined. Neither the presence in the feed of nitrogenous substances other than protein nor the quality of the protein itself is taken into consideration.

The kind and number of each amino acid in a feed determines the quality. At the present time, twenty-three amino acids are known.

It has been well established that the amino acids lysine, tryptophane, cystine, and histidine are indispensable dietary components for the normal growth and nutrition of animals. Many other amino acids may be necessary for the normal functioning of the animal body but, as yet, their values have not been clearly established.

The available information on the amino acid structure of proteins of different feeds is very meager.

Corn, wheat, oats, and barley are the most common cereals available for swine feeding.

Corn is the most important swine feed because of its availability and its high carbohydrate

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content. Corn is low in its protein content, ranging from 7.5 to 10.1 per cent. The protein is low in the amino acids cystine, lysine, and tryptophane which are necessary for animal life.

Wheat is about equal in value to corn in total digestible nutrients and net energy but ranks a little higher in total protein and the quality of protein. The total protein percentage ranges from 9.9 to 13.5. The protein is higher in the content of tryptophane and lysine than in corn.

Barley is a satisfactory feed for pigs, especially if thoroughly ground. It is a little lower in feeding value than corn. The total protein percentage ranges from 8.7 to 12.8. Proteins of barley contain more lysine than the proteins of wheat and more tryptophane and lysine than the proteins of corn.

Oats are not as valuable a feed for swine as corn, wheat, and barley because of the high percentage of fiber.

Oats have about 10.6 per cent fiber. The protein content of oats varies widely for the different sections ranging from 9.0 to 12.3 per cent. Oats are high in the amino acid lysine, but tryptophane is entirely lacking.

Linseed oil meal is frequently used as a supplement to corn for the purpose of increasing the protein content of the ration. Linseed oil meal or cake from North American flaxseed usually contains at least 34 per cent protein and often more than 36 per cent. The protein is relatively high in lysine but low in tryptophane and cystine. Therefore the protein of linseed oil meal will not completely supplement the protein deficiencies of the cereals. Poor results have been obtained in growing and fattening pigs when linseed oil meal was used as the sole protein supplement to corn.

Cottonseed oil meal is practically equal to linseed oil meal from the standpoint of quality of protein. No supplementary relations have been established between the proteins of the meal and the proteins of corn. The amino acid deficiencies have been found to be about the same as those of linseed oil meal.

Soy bean oil meal is an excellent high protein feed for swine. The proteins of soy bean oil meal are high in lysine content and low in tryptophane and cystine content. Soy bean oil meal furnishes more total digestible nutrients than are furnished by linseed oil meal or cottonseed oil meal. It is considered to be superior to linseed meal or cottonseed meal as a source of protein for swine.

Alfalfa meal supplies a protein relatively high in the amino acids tryptophane and lysine. The protein content ranges from 10 per cent for the meal made of stems

to 21.1 per cent for the meal made entirely of leaves. Alfalfa meal is high in the fiber content, ranging from 14.1 to 36.2 per cent, which is objectionable for a protein supplement for pigs.

The 60 per cent protein digester tankage is a valuable source of protein and is a feed low in fiber. The protein from packing-house by-products is low in the amino acid tryptophane, therefore a poor source of protein when used as a single supplement. The 60 per cent protein tankage has from 15 to 25 per cent of the protein in the form of "stick" which supplies protein of poor quality.

Meat scraps or dry rendered tankage contains from 35 to 55 per cent protein, none of which is obtained from "stick."

Wheat bran supplies a protein rich in the amino acid tryptophane; but wheat bran is bulky and extremely high in fiber.

Corn gluten meal supplies a protein relatively high in tryptophane, which makes it a valuable feed to add to those protein feeds commonly deficient in the amino acid.

The protein requirement of pigs has been estimated to be approximately equal to 18 per cent of the total feed allowance for each day. The most accurate method of fulfilling this requirement is to make a mixture of proteins from the various sources. Mixtures of protein supplements have been developed from investigations which are safer and more efficient for pigs than any common single supplement. The first of these mixtures studied was the combination of 50 pounds tankage, 25 pounds ground alfalfa hay, and 25 pounds linseed meal. This combination is now generally called the "trio mixture," the "Wisconsin mixture," or the "trinity mixture." Experiments have shown that pigs fed yellow corn and tankage gained .96 pound each day, on the average, while those fed corn and the trio mixture gained 1.14 pounds a day. Still more important was the fact that practically all of the pigs remained uniformly thrifty on corn and the trio mixture, and continued to make efficient gains even under winter conditions. The pigs on yellow corn and tankage did not thrive, and showed definite symptoms of rickets in spite of the fact that the pigs were provided with outdoor exercise lots.

How Forests Retard Floods

Condensed from American Forests

Charles F. Brooks and Henry I. Baldwin

ENGINEERS, beaten by big waters in flood, have turned to the damming of the little waters, to prevent their reaching the big waters all at once. Foresters are working still farther upstream, in fact, covering the entire watershed so far as present needs of agriculture for cleared land permit. Nobody, in the face of the abundant evidence now available, can deny that forests are a great deterrent of floods.

Yet the reasons in any one case are not always apparent. Floods are caused by one combination of conditions in one instance and by a totally different set at another time and place. Much has been written about the regulating effect of the sponge-like humus of the forest floor. But what if this soil cover is saturated, frozen, buried under deep snow? Is the forest then of no avail? Or,, what if the forest has been cut and replaced by brush and sprouts? Is such cover equally potent?

Forests influence the way rain and snow are received and run off on the earth's surface quite differently at different seasons of the year, differently on steep mountains from on plains and with every new complex assortment of storms.

Forests are the characteristic natural vegetation of humid climates with abundant snow and rain, and it is precisely in these regions where floods have always occurred even when the forests were unbroken, and man had influenced the soil little if at all. No one will deny that man has profoundly altered natural conditions in a multitude of ways and also that floods are more destructive of life and property than at an earlier stage of settlement. Yet there is a distinction between floods and the destruction caused by them. Floods became destructive only when human life and property was placed in the path of the waters by man's encroachment on the ancient flood plains of the rivers, and when flood crests were raised and hastened by quick runoff on the denuded and often eroded hills of the watershed.

The first attempts at flood control were always remedial, rather than attacking the causes. Levees and dams are costly frontal at-

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tacks at an unfortunate point in the water cycle where the river is strong and man is weak. A more strategic point of attack is at a place and time when the rain drops come down and they have not yet gathered strength. It is here that forests have played their part and very effectively too.

There is the matter of precipitation. Interception of snowfall by dense young spruce may be as much as 999 parts out of 1,000, leaving only one to reach the ground. This intercepted snowfall later blows away and is largely intercepted again or it evaporates or it melts and drips to the ground. All forests are not of young spruce, so the amount of interception is extremely variable, though always more in coniferous forests than in hardwoods, often four to five times as much. In ponderosa pine forests in Idaho, up to the time of wait too long!
maximum snow depth, twenty-seven per cent of the total snowfall had been intercepted by virgin forests, twenty-two per cent by mature stands, and eight per cent by young open stands.

A good illustration of the way snow is intercepted by trees was the snowstorm of March 20, 1937, in southern New Hampshire, when fourteen inches of wet heavy snow fell at Hillsboro. On March 24, long after all snow had evaporated from the trees, the following readings were made at the Fox Research Forest on permanent snow stakes carefully set on level ground before the ground froze. Stakes were set in pairs, one under the forest canopy as far as possible from tree trunks, and one nearby in an opening for comparison.

	Depth of snow (inches)	
TYPE	In forest	In opening nearby
Exposed open hilltop ..		8
Twenty - thirty year old paper birch ...	9	10
Thirty-forty year old white pine	7	13
Fifty-sixty year old white pine	5	13

Further, rain is partly retained by trees and later evaporated from the leaves and branches. Light showers may be completely intercepted in this way. Rain sometimes freezes on trunks and evaporates. The taller the trees and the more the forest is filled with trees of various ages and heights, the thicker the maze through which raindrops must spatter. This is important, since it is sometimes claimed that low brush or sprout cover is as effective as high forests in reducing floods. Broad-leaved trees are more efficient natural umbrellas than evergreens when they are in leaf, but frequently floods occur when they are bare of foliage. Measurements show that one-sixth to one-third of the total rainfall may fail to reach the

ground. What does not reach the ground cannot run off and add to flood waters, and when one-quarter of the rainfall is withheld—or even delayed—it may make the difference between a usual spring freshet and a disaster.

During prolonged downpours the proportion intercepted is diminished, but the time during which rain reaches the ground is prolonged and it strikes less violently. Extending the time over which rain reaches the ground means that less water reaches the ground each minute than if no trees interposed and thus, less is available to swell the flood. Beating raindrops quite often start soil-washing and erosion.

Water sinks easily into forest soils. Recent experiments in Switzerland showed that it took the same rainfall five times as long to sink into soil in the open as in the forest, and about thirty times as long if the soil had been compacted by grazing. The rotten wood and litter of the forest floor, as well as the decaying vegetation, often known as the duff, absorbs and holds tenaciously enormous quantities of water. In the open such vegetable remains are quickly consumed and blown or washed away. This mantle of non-conducting organic matter protects the mineral soil from freezing as deeply in the forest,—only sixty per cent as deep as in the open—and thus makes possible percolation of water deep into the soil when bare soils are strongly frost-bound. Furthermore freezing in the forest is delayed one month over that in the open.

Trees themselves use huge quantities of water during their growing season. Measurements of transpiration show that astonishing quantities of water are absorbed by tree roots, taken up by the sap stream and evaporated from the leaves. With certain types of forest, this may equal the summer rainfall. Considerable water, too, is used by the trees in growth. More than half of wood substance, chiefly cellulose, is water, and during the season when trees are not in leaf their trunks are often filled with absorbed water. Deciduous forests use ten or more times as much water as evergreen conifers, but both in the vegetative season quickly reduce the soil moisture, thereby tending to keep the forest floor always ready for the sinking in of a goodly percentage of any water which penetrates the leaf canopy.

It is a matter of common observation that in the forest the winter's snow cover lasts days or weeks after it has disappeared in the open. In the densest forests, interception will prevent so much snow from reaching the ground

that there will not be so much snow to melt as in ordinary forests. On the other hand, there is not so much sunshine or wind to melt it. But since it is common observation that the snow stays longer on the ground in the forest than in the open it is obvious that the effect of interception in reducing the catch is not so great as the effect of the foliage in reducing the rate of melting.

Here is where the influence of forests on winter and spring floods in cold regions is most important and far-reaching. Based on observations during the snow melting of the great flood period of March, 1936, it appears that during a warm windy rainstorm sixty-five per cent of the snow in the open will be melted by the wind, the contributions of conduction of heat from the air and latent heat from condensation on the snow surface being about equal; twenty-five per cent of the snow will be melted by the insolation, and ten per cent by the warmth of the rain. Numerous observations prove that wind movement is twice to nine times as great in the open as in the forest and least in the densest all-aged forest. In a dense evergreen forest, the melting will be about one-fifth as much from wind, one-third as much from insolation and three-quarters as much from rain, making the wind effect about forty-five per cent of the total, the insolation thirty per cent, and the rain twenty-five per cent. While a whole layer of twenty-four inches might melt in the open, only seven inches or forty per cent of the eighteen inches—after interception of six-in the forest would melt.

The remnant of snow cover in the forest is of utmost importance in flood prevention during great rainstorms, such as occurred in the northeastern United States in March, 1936. Even a dense springtime snow cover is half to three-quarters air. So a foot of snow in the woods can obsorb six to nine inches of rainfall, or, we should say, the six to nine inch unintercepted remnant of an eight to twelve inch rainfall. On a slope, all this water would not stay put, of course; nevertheless, it would take time for it to work its way to channels and into the streams. The snow cover would in this way augment the damming action of the innumerable leaves, twigs, branches, and logs on the forest floor.

When one considers the thousands of gallons thus held in restraint on one acre, and the thousands of acres over which this condition prevailed, it will be realized that here was one of the most striking demonstrations of protection by the forest. Everyone could see that after the flood snow still lay knee deep in the

forests, while the surrounding open hills were bare.

In addition to intercepting, absorbing, and holding water in different ways, the forest also profoundly affects the rate and manner in which it runs off the surface to streams, or filters slowly underground. More water sinks deeply into the soil in the forest because even mineral soil accumulates to a greater depth in the forest. Even though this deep-seeping water emerges along the streams later, the delay is such that the main crest of a flood will have passed long before the main body of this water comes to sight again. In fact, it is the slowness of movement of the ground water which maintains a considerable flow of streams in a forested region for weeks and even months after the water has sunk into the ground. The water which passes off over the surface is of chief importance in floods. Here again the litter on the ground in dense forests obstructs and delays its passage; the snow, if any is present, does the same.

Above all, dense tree growth is the best protection against erosion. Eroded lands have been found to have far greater and more rapid runoff in experiments conducted by the Soil Conservation Service. A few figures may illustrate:

Cover on Watershed	Erosion: Tons of soil removed per acre by the water in a year	Runoff: Per cent of rain
North Carolina		
Fallow land	64.6	29.6
Cotton land	22.6	10.2
Grass land	0.012	0.34
Forest (litter burned)	0.63	3.6
Forest (virgin unburned)	0.0021	0.12
Tyler, Texas		
Fallow	10.3	17.2
Cotton	19.1	19.5
Grass	0.18	1.3
Forest (litter burned)	0.19	2.7
Forest (unburned)	0.083	0.7

This shows the extreme importance of preventing forest fires. Other studies in Idaho showed that the water-holding capacity of an eroded soil was 44 per cent and the same soil uneroded nearly 81 per cent or nearly twice as much. It is significant that where much erosion is in progress dams intended to control floods, quickly fill with silt, and even river bottoms build up, requiring constantly higher and higher levees. Runoff is influenced by many factors, such as the character of precipitation, geology and soils, topography—especially the degree of slope, and the character of surface and vegetative cover. The last is the only factor which it is within human power to control, and the easiest way to control runoff is by forest management.

Inbreeding — Its Place in the Breeding Program

Condensed from The Shorthorn World

L. M. Winters
University of Minnesota

DURING recent years there has been a great increase of interest in inbreeding. Because of this, it is well that we consider carefully its place in our plan for livestock improvement.

Inbreeding (the mating of closely related individuals) coupled with careful selection is the quickest and most certain method of purifying a strain. Inbreeding is as a tool which separates out the various parts. It brings out the bad to a much greater extent than the good. A reason for this is that the good is often a composite quantity made good because of two, three, or more inherent qualities, and when these are separated from one another, the good is no longer apparent. The good will, however, re-appear when these parts are again fitted together.

This process of taking apart and putting the pieces together again has been used very effectively in breeding improved crops. It has not yet been used with success in livestock breeding. It would appear that we might copy from plant breeders' methods, but we do not yet know just how to carry this out to best advantage in livestock. Some day we will know much more about it, as the result of the several experiments now in progress.

We know that, in general, the breeders who have left an impression on the breeds used inbreeding. A study of breed history shows that the breeders first laid in a foundation of as good stock as the breed had to offer. In many instances years were taken for this laying of a foundation.

We also find that, in most instances, these breeders proceeded very cautiously with inbreeding. They selected very carefully the stock that was to be inbred. They selected not only on the basis of the superiority of the individuals concerned, but as to their ancestry. In many instances, the sire to be used was first given a trial as a breeder. Many of these men used a system that has probably never been equaled; they loaned prospective young sires and they studied the progeny carefully as to which one was likely to aid in

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improving the parental herd. In other instances, a promising son of the sire sold or loaned was taken to the parental herd.

In rare instances we find the proved sire used on his own daughters. It is likely that this method could be used much more than it has, but on the other hand, it is rather close, and the breeder need not be surprised at many rather inferior individuals coming from such a mating, even of carefully selected stock. Not long ago I visited a Guernsey herd which had a well-proved sire at its head. The bull was used on several of his daughters. The result was several calves which were very weak at birth and died shortly afterwards, but one very beautiful heifer was born and raised. So far as this breeder was concerned, he felt this one good one was worth the loss of the others. It was a price that he was willing to pay, and he is now using the bull on more of his daughters in the hope of getting a few more of the good ones which will give him a new foundation for his herd.

It is rather odd that more livestock breeders in America have not followed more closely the works of N. H. Gentry and A. J. Lovejoy. Both of these gentlemen developed unusual herds of Berkshire swine with what was as close to a system of breeding as anything ever developed. What is more, the method is not especially difficult, but it does call for judgment. The herds were first brought to a high point of perfection through careful selective breeding. The second step was finding an outstanding sire. The following sires were selected from the chief herd sire's sons, or in Lovejoy's case, by bringing in an outbred female outstanding as an individual and in ancestry. She was bred to the proved herd sire, and from the mating a new herd boar was expected. If the results were satisfactory, the new herd boar was used freely on his half sisters. And so the process continued.

On the whole, this is a simple method and one that proved very successful. It is, of course, much easier in application in swine than in cattle, for the reason that a litter affords much more chance for selection than is allowed by single births as in cattle.

Only the other day I heard of two herds of swine that had been built to a high point of perfection by a slightly different application of essentially the same principle. The method used was to place promising boars out on lease or sales with options. Then, when a good one appeared, he, or a good son, would be taken back to the parental herds. In some cases, the application of this method calls for rather close inbreeding, but some of "the shot

in the dark" is eliminated by the careful testing of each sire before his use.

Every mating carries some inbreeding and some crossbreeding. It is merely a matter of degree to one side or the other; when we mate closely related animals the inbreeding is increased; when we mate animals of different breeds, the cross is widened.

Many breeders hope and hunt for a successful "nick." Frequently this is obtained by mating animals of different types. The effect, when successful, is very gratifying in its immediate result. It, however, is a mild form of cross-breeding. It retards purification and the attainment of uniformity which are so much to be desired in the best of purebreds.

It would be a fortunate development for the breed if several breeders were to develop herds along strictly different family lines through a system of careful selection coupled with some inbreeding. The old family method, whereby each breeder had a dozen or more so-called families, did not mean very much because actually, all the families in a given herd were usually rather closely related. But, if each herd was developed as a family, the significance would become much greater. Once these families were developed, crosses between them woud likely give very regular and beneficial results for immediate use in commercial production.

The Shorthorn breed is likely in about the most fortunate position of any breed to develop families with marked differences between them, since the breed does cover a rather wide field so far as types and uses are concerned.

In the future we are going to be much less afraid of both inbreeding and crossbreeding. We will come to use each in its proper place. Inbreeding is not to be used indiscriminately or disaster is bound to result. Only the best herds are in a position to benefit from inbreeding and even here it must be used with care, or the expense may be rather heavy. On the other hand, if used carefully and with the best animals the breeder may accomplish much that he had been hoping for but had failed to do with outcrosses.

Farm Credit

Condensed from The Nation's Agriculture

Edwy B. Reid

THROUGH 550 production credit associations serving every county in the United States, 250,000 farmers are making more money by borrowing at lower rates of interest and they are getting their loans for periods which are comparable to the time required to complete the farming activities so financed.

This form of credit, sponsored by the American Farm Bureau Federation more than a decade ago, had a rather feeble career until the Farm Credit Administration was established four years ago and provision made for seting up a nation-wide co-operative system.

At present about 215,000 farmers have these short-term loans, the average size of which is about $750. Each year since the winter of 1933-34 farmers have brought their associations an increasing amount of business and this year it is from 20 to 50 per cent ahead of last year.

And what has been the record of these associations which started from scratch with new boards of directors and officers in a field in which few had had much experience?

S. M. Garwood. Production Credit Commissioner in Washington, points out that on June 1, this year, only 1.44 per cent of the associations' loans were delinquent for as much as 30 days.

Nearly a quarter of a million farmers getting these loans are keeping their credit good. They know a good thing when they see it, and they are building permenent, co-operative institutions.

For more than two years now, the Production Credit Association has made loans at a uniform interest rate of five per cent a year.

Farmer-members borrow for the period suited to the operation being financed.

Members pay interest on their loans only for the time they have the money.

About half of the borrowers from production credit associations find it not only convenient but much cheaper to adopt a budget form of borrowing in which they indicate at the beginning the approximate amount they will need during the season and it is

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advanced to them as they require it. For example suppose you wanted $1,000 all told but you wanted it $250 at a time, when you plowed, sprayed, cultivated and harvested, at equal intervals. The budget plan would cut your interest charges in half.

Production credit associations are run by farmers for farmers—on a business basis.

They know when you have a good chance to make a profit and they also have first-hand knowledge and experience which may be worth money to you when you go to borrow.

Borrowers in increasing numbers are becoming conscious of the advantage of paying cash for what they buy and securing a discount. They are beginning to realize that it is cheaper to borrow from their production credit association and pay interest to it than to pay the long price which accompanies merchant credit. Most of them are shocked when they actually figure out what they pay in interest when they run a charge account or buy on the installment plan. Production credit associations are having little difficulty in showing farmers how they can save by using cash to purchase supplies.

One third of all the farmers in the United States are said to use short-term credit sometime during a year. This means about two million farmers. The production credit associations, with a membership of a quarter of a million farmers in four years of operation, represent substantial, steady progress. And what is more important, the members are really interested. More than 113,000 attended stockholders' meetings last year.

Fertilizing Small Grains

Condensed from The Southern Planter

Dr. T. B. Hutcheson

ALTHOUGH we grow four important small grain crops —wheat, rye, oats, and barley—in Virginia, except for a few minor variations, their fertilizer requirements are not markedly different. If we group these crops according to their ability to grow on thin land, we would place rye first, oats second, wheat third, and barley fourth. Barley is the most exacting of the group because it does not survive severe winter freezes unless a good root system is established quickly after seeding, and the straw is likely to be weak and short on thin soils. For these reasons, barley should not be sown on land that is not capable of producing at least 35 bushels of corn to the acre, unless it is well fertilized at seeding time. Wheat is somewhat less exacting, but winter killing is usually very severe on thin fields in Virginia. Oats being a gross feeder with relatively stiff straw will make some crop on almost any type of soil, provided there is plenty of moisture during the growing season, and winters are mild. However, this crop responds more readily to proper plant food applications than any of the small grains. Rye is the hardiest of the group and gets high enough to cut even on very poor soil. For this reason it is likely to become the most important small grain where the soils are thin and late seeding is practiced.

In considering the fertilizer needs of any crop, it is well to first find how much plant food it removes from the soil and then undertake to see that the cropping system and fertilizer practice, at least approximately, supply these needs. The following table compiled from Henry and Morrisons "Feeds and Feeding" shows the amounts of nitrogen, phosphoric acid, and potash removed from the soil by comparable yields of small grains which may be expected under good farming conditions.

Table I

Name of Crop	Yield per acre	Plant food removed per acre		
		Nitrogen	Phosphoric Acid	Potash
Wheat with straw	25 bu.	38.9	18.4	27.4
Rye with straw	25 bu.	43.7	19.3	32.2
Oats with straw	40 bu.	41.2	20.2	40.6
Barley with straw	35 bu.	49.9	17.4	31.9
Average		45.9	18.8	33.0

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It may be observed that these crops do not differ to any appreciable extent in their draft upon the soils resources, and that all of them are heavy feeders on nitrogen and potash. The average amount of plant food removed from the soils by these crops is approximately equivalent to that found in 225 pounds of a 20-8-15 fertilizer. No Virginia farmer ever heard of such an odd analysis being used on small grains, nor does any experiment station recommend it! Yet this amount of plant food actually goes away from the field when the crop is taken off, and the only way we can justify a different analysis is to provide a part of the plant food from other sources than fertilizers. For average Virginia soils we may reason that a considerable part of the nitrogen may come from legumes and that most of our soils contain large stores of potash, a part of which may be made available for plant use, if the soil reaction is kept right and a good farming system is followed. This line of reasoning is checked by numerous field experiments. However, very few Virginia soils contain enough available phosphoric acid to produce a profitable small grain crop even in good rotations on well limed soils. For this reason small grain fertilizers are usually formulated and rates recommended that will supply at least as much phosphoric acid as is taken out by the crop and some nitrogen and potash to supplement that made available by the cropping system.

It is obvious from the above discussion that it is necessary to know the rotation followed before one can advisedly recommend a proper fertilizer for a small grain crop. One of the most logical rotations for small grains from the standpoint of soil protection and economy of labor is a cultivated crop, such as corn, potatoes, tobacco, tomatoes or soybeans, followed by small grains and these by clover and grass for one or more years. The fertilizer applications for the small grain would, of course, vary with the kind and amount of fertilizer used on the previous crop. For example, if small grain followed dark or burley tobacco, which had received manure and a heavy application of complete fertilizer, or a heavily fertilized potato crop, no fertilizer should be used. However, if it followed bright tobacco on light soil low in organic matter, even though 1,000 pounds of 3-8-5 fertilizer was used to the acre on the tobacco, 100 pounds of nitrate of soda or equivalent amounts of nitrogen from some other quickly available source as a top dressing in early March would normally pay good dividends.

In like manner, if manure is used in the rotation, a different

fertilizer treatment would be advisable. Six tons of well preserved farm-yard manure plus 400 pounds of 16% superphosphate contain approximately as much plant food as 1,000 pounds of 5-10-5 fertilizer. Therefore, in a rotation of corn, small grains, and clover, where the corn land is well manured, two hundred pounds of 16% superphosphate or its equivalent in other forms to the corn and small grain crop would be sufficient.

However, in a rotation of corn, small grain and clover, where no manure was used, some potash will usually be necessary to supplement that already in the soil, and we would suggest 300 pounds of 0-12-5 fertilizer to the acre for both corn and small grains. In case the clover failed or was rather light, preceding the small grain crops, the same amounts of fertilizer should be used, but the analysis changed to a 4-12-4 or 4-16-4, as nitrogen will also be low in the soil. In a five year rotation of corn, small grains, clover and grass the rotation is too long to depend upon the legume to furnish all of the nitrogen, and it will usually be found profitable to use 300 pounds of a complete fertilizer to the acre, such as a 4-12-4 or 4-16-4 on both small grain crops. The legumes should be watched carefully and where they fail, or no part of them is returned to the soil, nitrogen should be used either in the fertilizer at seeding time or as an early spring top dressing. Where seedings are late and on very thin soils, the rates of application suggested should always be increased.

The reaction of the soil also has an important bearing on the use of fertilizers. The types of rotations suggested for small grains requires a soil reaction of pH 6 to 7 for best results. On the clay and loam soils, which are the best grain soils in Virginia, 2 tons of ground limestone or its equivalent in other forms, as an initial application where no lime has been applied in recent years, is usually required to bring about the desired reaction. One ton of ground limestone every four to six years thereafter will normally maintain the proper reaction.

The figures in Table II indicate how much more efficient the fertilizers have been in improving the soil where lime has been used.

We see from this table that where lime and fertilizers both have been used, the productivity of the soil has been built up to where profitable yields may be produced, but where fertilizers and no lime have been used, the yield is still below the cost of production.

In conclusion we may say that no hard and fast rule may be laid down for fertilizing small grains that will fit all conditions,

and that fertilization should vary with the cropping system and fertilizers used on previous crops. However, under average conditions the following practices will normally give paying results:

1. After potatoes, dark and burley tobaccos, where manures or heavy applications of fertilizer have been applied to the row crop, no fertilizer should be used.

2. After heavily fertilized bright tobacco on light soils 100 pounds of quickly available nitrogen fertilizer as an early spring top dressing.

3. Where heavy applications of farm manure are used in a short rotation, 300 lbs. of 16% superphosphate to the acre.

4. In short rotations where a legume or sod is plowed down every 3rd year, 300 lbs. 0-12-5 fertilizer to the acre.

5. In long rotations where the legume is more than two years away from the grain crop, 300 lbs. of 4-12-4 or 4-16-4 to the acre.

6. On any thin land which has had neither manure nor legumes for three or more years, 300 to 400 lbs. of 4-12-4 or 4-16-4 to the acre.

7. Always consider previous fertilization and see that the plant food supplied closely approximates that removed in the crop.

Table II

Effect of Lime on the Efficiency of Fertilizers on wheat crop at Chatham, Virginia, in 1936

Treatment per acre	Yield in bushels per acre	
	With lime	Without lime
200 lbs. 16% Superphosphate	27.0	8.6
400 lbs. 16% Superphosphate	24.7	6.5
200 lbs. 16% Superphosphate 25 lbs. Muriate of Potash	19.6	8.0
200 lbs. 16% Superphosphate 25 lbs. Muriate of Potash 90 lbs. Nitrate of Soda	26.8	12.5

Cow Testing in Denmark

Condensed from Hoard's Dairyman

Mogens Plum

THE first co-operative cow testing association in the world was started in Vojens, Denmark, in 1895 by Mrs. Anne Hansen who suggested this co-operative enterprise after she and her husband had tested the milk of their own cows for several years. But as early as 1837 special prizes were given at the Danish cattle shows to the cows that gave the most butter. In the 1840's a regular control of the milk production of the cows was started on several larger farms. A special testing churn by the use of which it was possible to determine the butter production of the individual cows was constructed in the seventies, and in the 1880's the experimental laboratory of the agricultural college in Copenhagen started a series of systematic investigations of the production of milk and butterfat of individual cows.

At this period great changes took place in Danish agriculture. In 1861 the average production of the Danish cows was 64 lbs. fat a year and the total export of butter about 13 million pounds. In 1881 the average production had increased to about 110 lbs. fat and the export to 26 million pounds of butter. Compare this last figure with an export figure of 330 million pounds butter in 1934. Before this period it was the larger farms which were the leaders in agricultural development, but a radical change in Danish agriculture became necessary because of the world conditions. Opening up virgin land in the United States and elsewhere made it impossible for the Danish farmers to compete on the world grain market and the Danes had to seek other channels to dispose of the agricultural production. Consequently more emphasis was put upon the production of "processed" agricultural products such as butter, bacon, and eggs.

In the early eighties the first co-operative creameries and slaughterhouses were started and when the first cow testing association was started, the co-operative idea had already had time to prove itself as an effective way for the individual farmers to tackle larger enterprises.

The Vojens cow testing asso-

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ciation started out on May 1, 1895, with 12 members. About 10 years later, at the time the first cow testing association was started in the United States in Fremont, Michigan, Denmark had about 300 associations with about 7,000 members and 112,000 cows. Ten years later, in 1915, there were 610 associations, in 1925 over 1,000, and in 1934 there were 1,579 cow testing associations with 48,948 herds and 678,402 cows with an average production of 298 lbs. fat. This means that almost 40% of all the cows in Denmark are tested.

The cow testing associations are one of the foundations for the whole agricultural system. The number of members may vary from 15 to over 30, depending somewhat upon the size of the herds but many herds consist of only a few cows and it is often arranged that the owner takes his own samples every other time. The societies receive an annual support of 75-100 Kroner (about $16-22) from the government if there are at least 10 members and 200 cows in the association. In return the tester has to turn in a summary of each cow's production to the agricultural society for the province in which the association is located. These provincial organizations also supervise the work in the cow testing associations and every year they publish the average yearly record for each herd in different associations.

There are areas in Denmark where as high as 70% of the cows are on test. On the Danish Islands, where the Red Danish cattle make up 95% of the dairy cattle, at least 50% of all cows are on test. In Jutland where the black and white cattle have been bred from olden times, but where also considerable numbers of Red Danish and Shorthorn cattle are found, the percentage of cows tested falls as low as 32%. There seems to be a tendency for Red Danes gradually to replace the other breeds as dairy cattle. One of the reasons given for this is that it is easier to select good breeding stock among the Red Danish cattle, because such a high percentage of the cows of this breed is tested.

The expenses connected with the operation of a cow testing association are low in Denmark. During the year 1933-1934 the average expense was slightly less than 50 cents per cow per year. Denmark is about 19,000 square miles and there are close to 1,600 cow testing associations. That means that the average association would cover an area of 12 square miles if they were equally distributed over the country. Consequently the testers get along perfectly well on a bicycle and make their round easily on this most dependable vehicle.

In order better to understand the place of the cow testing association in the Danish agricultural system, it is well to recall the general set-up of the agricultural organization in Denmark. The whole system may be pictured as a pyramid where the cow testing associations, bull societies, and other societies working in a local community form the base. The different local organizations are united in county organizations and these again in joint provincial associations. The top is formed by the Agricultural Counsel which represents all Danish agricultural interests.

At the present time there are more than 50 consultants in Denmark in county and provincial organizations who devote their entire time to dairy cattle work. Besides looking after the work in the associations they assist the bull societies and help prepare information about pedigrees and yield of animals to be exhibited at cattle shows. They also have charge of the registering of animals in the herd books and the progeny testing of bulls.

There has never been any kind of official testing in Denmark and the C. T. A. records have been used in a more or less official way. In Denmark the requirements for entry in the herd books are based on C. T. A. records.

The Danish herd book system is another example of the use which is made of the records of the control societies. All cows in a herd which is controlled in a cow testing association which receives government support must have an indelible mark of identification, and a record of the birth is entered in the C. T. A. book. These records are later transferred to the farmer's "family herd book" by one of the consultants of the agricultural societies who comes around usually once a year and checks the information contained in the C. T. A. book.

The first herd book to appear in Denmark was published in 1881. The herd books always give a complete pedigree of the animals besides a description and information about the life production of the cows.

The cow must have had a certain minimum of production and must be of recognized type either by having won prizes at cattle shows or by having passed a scoring by a special committee.

The entrance requirements are an average production of almost 400 lbs. fat for at least three years and usually at least 4% fat. This minimum requirement is, however, always exceeded by a wide margin.

The improvements in the production of the herd book cows may be illustrated by the fact that the 100 Red Danish cows which were admitted to the first

volume of the present herd book in 1921 average 9,700 lbs. milk with 4.08% fat, while the 211 cows admitted to the fifteenth volume published recently, averaged 11,940 lbs. milk with 4.31% fat, or almost 120 lbs. fat better than the cows 15 years ago.

Older bulls are never judged individually at a cattle show, but are rated according to the type and production of the offspring. At least two-thirds of the progeny of a bull have to be exhibited in order that he may be awarded a prize for type and his milk producing ability is judged by the records of his female offspring.

Soybeans in Relation to Soil Improvement

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BECAUSE the soybean promises to continue to hold an important place in agriculture, it is important to recognize its limitations as well as its virtues.

Only by recognizing these limitations and by following practices which will minimize these shortcomings, is it possible to obtain the maximum values from the use of the soybean in the rotation.

Even though the soybean is a legume, its growth habits and the usual method of handling prevent it from functioning as a soil-improving crop to the same extent as the clovers. Only one-tenth of the soybean plant is contained in the roots, whereas one-third of the clover is found below ground. Thus, the removal of the soybean crop from the land removes most of the plant nutrients contained, whereas one-third of the nutrients in the red clover plant remain after harvesting. Because only approximately two-thirds of the nitrogen in well-nodulated legumes is secured from the air, and because only one-tenth of the plant is contained in the roots, no nitrogen is actually added to the soil by the soybean unless a considerable portion of the plant is returned to the land.

Like all other legume crops the soybean removes large quantities of minerals from the soil. This fact is illustrated in Table 1.

Table I—Plant Food Elements Added and Removed by Various Crops

Crop	Acre yields	Nutrient elements per acre					
		Added	Removed				
		N	N	P	K	Ca	Mg
		lb	lb	lb	lb	lb	lb
Corn	40 bu.	....	40	7.0	8.0	.4	2.8
Oats	40 bu.	....	26	4.5	6.5	.8	1.6
Wheat	25 bu.	....	36	6.0	7.5	.5	2.0
*Soybeans	20 bu.	16	..	8.0	25.0	2.8	3.0
**Soybeans	2¼ tons	....	80	13.0	80.0	72.0	31.0
**Red clover	2 tons	....	..	10.0	60.0	64.0	18.0
**Alfalfa	3 tons	....	..	13.0	96.0	120.0	24.0

*Soybeans sold—straw returned.
**Hay sold—no manure returned.

These data indicate that the soybean removes larger quantities of phosphorus and potassium from the soil than a corresponding crop of corn but not as large an amount as red clover or alfalfa.

Where the soybean crop is harvested with a combine there is a slight addition of nitrogen to the soil provided good nodulation is obtained, but the use of the soybean as a hay crop with no return of manure results in a loss of nitrogen as well as a loss of mineral elements.

Like most legume crops the soybean improves the tilth of the soil—that is, the soil is loosened so that it "works" well. This loosening effect may be helpful or detrimental, depending on the method of farming employed.

Data from the Missouri Agricultural Experiment Station show that the soybean crop contributes greatly to the erosion problem on rolling land, particularly where the crop is grown in cultivated rows up and down the slope. If seeded solid and across the slope, the tendency for erosion is greatly decreased.

Fall seeding of small grain in the soybean field is another practice which decreases erosion and leaching losses. Wheat and rye have been used extensively for this purpose, while winter barley offers some possibilities in the southern half of Illinois.

Occasionally low yields of winter grain—particularly of wheat—are secured after soybeans. Consequently some farmers have hesitated to follow the practice of seeding winter grain on soybean stubble land. Comparatively recent data indicate that the use of phosphate fertilizer drilled with the wheat will greatly improve wheat following soybeans on soils where the amount of available phosphorus is low. An increase of at least 10 bushels per acre as a result of phosphate fertilization where wheat follows soybeans has been observed fre-

quently. On some soils, the addition of fertilizers containing nitrogen and potassium may be important.

The best results are secured where considerable time elapses between the harvesting of the soybean and the seeding of the next crop. Consequently oats and corn have been more satisfactory as a crop to follow soybeans than the fall-seeded crops when judged by crop yields. Thus, on level land where erosion is not the most important factor to consider it is frequently desirable to follow soybeans with oats or corn.

Soybeans may be used effectively as a green manure crop under special conditions which occur when other legumes fail, or in crop adjustment programs. It is believed, however, that it would be preferable, ordinarily, to sell the seed or hay and purchase limestone in order to establish a permanent soil building program instead of depending upon soybeans for the temporary improvement of acid soils.

Where used as a green manure crop well-nodulated soybeans add amounts of nitrogen varying from 60 to 100 pounds an acre, organic matter equivalent to 4 to 8 tons of farm manure, and in addition return to the soil considerable amounts of mineral elements which may be used by succeeding crops.

To obtain the best results with soybeans as a green manure crop it is desirable to have a crop growing on the land soon after plowing. Thus where a good seedbed can be prepared it is wise to follow the soybeans with a fa seeded grain crop.

Although the evidence is not abundant on this subject, it appears to be good practice where corn is to follow the soybeans to plow them under as late as possible and still prevent a loss of leaves from the land. Thus it is desirable to use a late maturing variety of beans which may be plowed under in October. On land which is rolling and subject to erosion spring plowing is preferable.

Some farmers have preferred to spring plow land from which beans have been harvested instead of fall plowing. Such a practice is desirable on rolling land. In most cases the land is in better physical condition where spring plowing is practiced than where it is plowed in the fall.

Contrary to the opinion of some, fall plowing does not have an unfavorable effect upon the nodule bacteria.

Although they usually have a favorable effect upon the crops which follow them, soybeans should be considered primarily as a cash crop. For soil improvement deep-rooted legumes such as alfalfa, sweet clover, and red clover are preferable.

The Control of the European Corn Borer

Condensed from Scientific Agriculture

Geo. M. Stirrett, Geoffrey Beal, and M. Timonin

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IN 1935, M. Timonin and I. L. Conners, of the Division of Botany, Experimental Farms Branch, showed in field experiments at Ottawa that it was possible to infect and cause the death of larvae of the European corn borer with *Beauveria Bassiana* Vuill. by the application of spores of this fungus to the infested corn. The borer infestation has been established artificially by the application of egg masses to the plants as the local natural infestation would have been both too sparse and too uncertain to assure suitable conditions for a satisfactory experiment. In 1936, as a result of these studies a comparable field test with natural infestation in the heart of the corn borer infested territory was suggested. Accordingly, the study was continued with the co-operation of the staff of the Chatham (Ontario) laboratory of the Entomological Branch.

Two problems of chief concern were to determine first, whether the spores of *Beauveria Bassiana* Vuill., disseminated in the field would reduce the population of corn borers in the Chatham region and, second, when the spores should be disseminated.

The isolate of *Beauveria Bassiana* Vuill, used in these experiments was obtained from mummified corn borer larvae, which had been received from the Dominion Parasite Laboratory, Belleville, Ontario. Spores were obtained in quantity for the field experiment by growing the fungus on soybean mash in petri dishes. The mash was prepared as follows: washed soybeans were barely covered with tap water and allowed to soak for 18 to 24 hours, then they were passed through a meat chopper and tap water was added sparingly to give the mash the consistency of porridge. Petri dishes, containing a thin layer of soybean mash, were sterilized in the autoclave for 30 minutes under 15 pounds pressure. After the dishes were cool, the medium was inoculated with spores of the *Beauveria* and incubated at 25°

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C. After four to five days of incubation the fungus developed a white, uniform growth of mycelium over the dish which rapidly assumed a creamy, chalky appearance with the copious production of spores. After the culture had partly dried up, the spores were brushed off the medium with a small brush and collected in a flask. The inoculum was prepared by thoroughly mixing together weighed quantities of spores and flour at the rate of 40 grams of spores to 16 pounds of flour. This inoculum was prepared in two lots, one for the first application and another for the second. The amount required for each block or plot was packaged separately at Ottawa before shipment. Slightly over 100 grams of spores were required for the experiment. As the yield per plate varied from 0.1 gm. to 0.4 gm., between 300 to 400 petri dishes were required.

Spores were applied on two dates, July 8 and July 19, at two levels, 0 grams and 40 grams, per acre. The two dates of dusting fell, respectively, early in the period of oviposition and at the height of the period. In the interval the corn had come generally into tassel. The inoculum was dusted with great care from a cheese-cloth bag into the throat of the corn plants and at the second application new growth received especial attention. It may be noted that the untreated plots did not receive an application of flour from which the spores were omitted.

The plots were square and contained 144 hills of the cross-checked corn used in the experiment. The two outer rows of hills on all four sides of each plot served as a buffer. Four plots, to each of which was assigned one of the treatments of Table 1, formed a square block. The treatments were randomized, independently in each block, as is common in agronomic research, by use of random sampling numbers, Tippet (6). The blocks, replicated fifteen times (see Table 2), form a contiguous and compact mass in one field. The four labourers who made the counts were allotted whole blocks so that variability between them would not affect the standing of the treatments. Also, each operation such as dusting or sampling was carried out on all plots of a block as nearly simultaneously as possible.

Records were secured from limited sampling, because it was required to take successive counts at each of which the material examined was necessarily destroyed. In sampling, from each plot eight hills distributed equally between four sub-plots were examined. The two hills from each sub-plot were chosen strictly at random for each count. The choice was again made with ran-

dom sampling numbers. A first examination was carried out, befor the great autumnal migration and reduction in population, during the period August 18-21, inclusive, a second during October 19-22, inclusive, and a third is to be made in the spring of 1937*. Before examination was undertaken the non-technical observers were instructed carefully in the differences between the various borers of corn and then given a cutting exercise for a morning.

In Table 1, the number per plot of corn borers, by treatments and by blocks, is presented for the counts made in August and October. The values show the total number of borers surviving in the eight hills examined in each plot at each time.

Table I—Numbers of Corn Borers Per Plot

	Treatment No. 1 No application		Treatment No. 2 Early application		Treatment No. 3 Late application		Treatment No. 4 Double application	
Block	First count of Aug. 18	Second count of Oct. 19	First count of Aug. 18	Second count of Oct. 19	First count of Aug. 18	Second count of Oct. 19	First count of Aug. 18	Second count of Oct. 19
1	38	13	24	7	28	11	22	3
2	39	33	47	39	29	4	19	19
3	41	39	68	25	36	16	23	13
4	27	42	71	11	45	18	34	4
5	50	14	31	25	26	11	45	8
6	65	49	73	57	57	16	63	13
7	59	39	88	30	49	13	55	19
8	52	21	45	12	35	5	43	6
9	77	26	47	18	35	1	82	12
10	84	44	59	31	58	22	45	9
11	61	40	64	28	50	12	50	15
12	38	19	51	19	13	9	32	11
13	62	47	107	24	46	8	59	7
14	136	26	79	27	39	20	72	24
15	88	32	90	27	68	12	74	18
Total	917	484	944	380	614	178	718	181

*All possibility of making the third count was removed by the accidental destruction of the overwintered corn stalks by fire, May, 1937.

The control ascribable to any treatment is determined below by finding the relative magnitude, expressed in percentage form of the number of borers by which plots subjected to the given treatment fell short of the number on plots subjected to no treatment or treatment No. 1. The reduction effected by the various treatments at the time of the August and October examinations is presented in Table 2.

Table II—Reduction in Population Effected by Various Treatments

	Treatment No. 2 Early application	Treatment No. 3 Late application	Treatment No. 4 Double application
First count of August 18	—3%	33%	22%
Second count of October 19	21%	63%	63%

From Table 2, it can be seen that an appreciable reduction in infestation had been effected by August and a very marked reduction by October. The early application was markedly less effective than the late. The negative redurtion found at the time of the count in August is ascribable to a chance excess of borers in the treated plots over borers in the untreated plots. Such a situation must tend to arise when no appreciable control is effected by a treatment. Double application apparently gave no effect over and above late application.

The present work indicates that by dissemination of the spores of *Beauveria Bassiana* Vuill, to infested corn plants a marked reduction in the population of corn borers may be effected.

Poultry Flock Improvement

Condensed from Plymouth Rock Monthly

J. C. Graham

Massachusetts Agricultural Experiment Station

THIS Flock Improvement Project was carried on at the Massachusetts Agricultural Experiment Station and it was proved that by following this method hatchery flock owners can develop a higher degree of efficiency in birds without undertaking pedigree breeding. It is termed a "flock improvement project" to distinguish it from pedigree breeding. In the former the flock is treated as a unit; in the latter the individual bird or family becomes the unit. In general practice this project does not necessitate trapnesting.

The purpose of the project was to determine whether it is possible to maintain or improve body weight, feather color, egg production factors, hatchability, and size, shape, and color of eggs without pedigreeing but through the annual introduction of new blood from reliable sources.

There is a very large group of poultrymen, reproducing their own flocks and selling hatching eggs and baby chicks, who would like to retain or develop the above characteristics in their flocks and maintain them at as high a point of efficiency as possible, but who do not wish to resort to the technical methods required in pedigree breeding or even to maintain selected breeding pens for cockerel production.

With the results of this project decidedly positive, its general adoption would mean a great saving in the production of good chicks by this group of poultrymen, many of whom are now trapping a portion of their flocks without adequate returns. Furthermore, pedigree breeders who furnish the hatching eggs or breeding cockerels under this plan will be rewarded to a degree at least for the large expenditure of time, money, and energy they are putting into their breeding program.

Hatching eggs were purchased for three successive years (cockerels the fourth year), from which enough breeding males were produced for the entire breeding flock. The pullets from these eggs were housed separately and their performance recorded as a check on their flock brothers.

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Well-selected eggs, pullets' 25-ounce, hens' 27-ounce, were stipulated when ordering. The eggs received were from trapped flock matings, the $15 to $18 per 100 grade.

The eggs were secured from reliable breeders who were known to be following an approved breeding program and whose stock was giving a good account of itself either at egg-laying contests or in the hands of their clients, or both.

The new blood was secured from a different source each year, in order to take advantage of hybrid vigor.

No hens and cocks were used, but the foundation pullets the first year and the hybrid pullets thereafter were mated to the new-blood males.

Hatching Period—The hatching period each year extended over a period of several weeks. This permitted a more careful selection of eggs than would have been possible with only one or two hatches, but made it more difficult to compare early maturity in each generation.

Rearing—All birds used in this project were brooded in colony houses and grown on a good grass range. The brooding and rearing units were reasonably small and the grass was good throughout the season. Growing shelters were used for the overflow from the brooder houses. From the close of the brooding period, cracked corn and mash were kept in open hoppers, accessible to the chicks at all times.

Housing—The adult birds were housed in pens 9 by 14 feet, with an opening 5 by 5 feet for each pen. The houses, therefore, were far from being comfortable in the coldest weather. During the breeding season, doors between pens were thrown open allowing freedom of mating for both males and females.

Feeding—The birds were allowed to balance their own rations from hoppers containing whole corn, whole oats, and mash.

Elimination—As this project does not entail trapnesting, the following methods were used to eliminate from the flock undesirable specimens, those that would not be suitable for the reproduction of the flock. All pullets on the range were carefully handled and only the choicest specimens were placed in the laying houses. In most cases this included about 75 to 80 per cent of the pullets raised. All small or backward pullets and those which were not good representatives of the flock were discarded.

Maturity—All birds were either toe punched or banded, and those not showing evidence of laying or not being about ready to lay at 210 days of age were eliminated from the flock, as this was the only method whereby early

maturity could be determined and maintained.

Body Weight—All birds not weighing over 5½ pounds or nearly 6 pounds at sexual maturity or soon thereafter were eliminated from the flock.

The last two years nearly all birds that did not show a gradual gain in body weight from the time they were housed until the breeding season, and especially those that had lost one-half pound or more during any month, were eliminated from the flock.

Birds that stopped laying for any great length of time for any cause whatever were not allowed to remain in the flock.

No broodiness was shown in any of these flocks; but had it made its appearance, the broody birds would have been removed before or during the hatching season.

From the time the pullets were housed in the fall until the close of the breeding season, specimens not meeting the standards on general appearance were removed from the flock. This included birds showing unusual fading in feather color, injuries, and the lack of those qualities associated with thrift and vigor.

All eggs from the flock for the first three days of each month were weighed and the average computed. This has proved experimentally to be a fair measure of egg size in a flock provided the percentage production is normal during these periods.

At broiler age about three times the number of males needed for the breeding pens were reserved, attention being given to size, type, vigor, color, and general uniformity. The elimination of undesirable specimens was continued throughout the growing season and fall months. Those finally placed in the breeding pens weighed from 8½ to 9½ pounds. The use of males above that weight was avoided in order to keep away from the meat or beefy class. Uniformity in type, color, and general appearance was adhered to closely.

Eggs were set weekly, and size, shape, and color were the bases of selection. In most instances not more than 75 to 80 per cent of the eggs gathered were placed in the incubator. The past two years the average weight of eggs on the incubator trays was close to 27 ounces to the dozen.

The 55 original pullets were from the experiment station flock, discarded because of family size, egg size, and possible deficiencies in other characteristics—in general, a fairly good commercial flock in all respects except egg size.

Each year the flock sisters of the males reserved for breeding were housed separately and a record of their performance kept.

Progress was made from year

to year in three important factors: body weight, egg weight, and production. Had the project been started with a flock of moderate or low quality, very material gains would have been anticipated; but as the foundation flock was made up of experiment station birds that had been carefully bred for nearly 20 generations, merely maintaining the level of the main factors and increasing egg size would have been highly satisfactory. However, the records show a steady advance in body and egg weights. With the exception of lower production in the second hybrid generation, which was influenced very greatly by unfavorable weather conditions during the fall and winter of 1933-34, fecundity was very satisfactory.

Experimentation has shown that hybridizing with strains as well as with breeds gives a decided improvement in hatchability. But in order to show definitely the difference in hatchability between the flock sisters of the males used and the foundation or hybrid flocks each year, a number of flock sisters were placed with the hybrid females so that they would be served by the same males. It was necessary to trapnest the females during the breeding season in order to keep the eggs separate. The hybrid egg hatched much better than the pure strain eggs.

It is reasonable to expect less hybrid vigor in the crossing of strains than in the crossing of breeds; likewise less in the crossing of strains that have been bred along similar lines than in those produced under breeding programs where aims and practices are more divergent. Although all flocks involved in this project, with the exception of Flock C, were produced under almost identical breeding programs, yet definite evidence of hybrid vigor is found.

In the case of body weight and egg size, based upon November and December weights, the hybrid flocks in every instance showed a gain over the average of the parents, the sisters' average being taken as a measure for the sires. Even the January weights, after rigid selection had taken place, indicated hybrid vigor in two cases out of the three in both body weight and egg size.

In the consideration of hatchability there is no question as to the part played by hybrid vigor, for the hybrid flocks were consistent in the production of eggs having a higher hatchability than those produced by pure lines, and their eggs hatched from 10 to 15 per cent better than those from the sires' flock sisters.

Diagnosis and Control of Mastitis

Condensed from the Jersey Bulletin

D. H. Udall and S. D. Johnson

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PUBLIC health officials and owners of dairy cattle are fast awakening to the importance of mastitis. When the cause of a milk-borne disease is traced to a cow, the animal almost invariably proves to be affected with mastitis. No person can estimate the economic loss caused by this disease; probably it exceeds that of either tuberculosis or abortion. In some herds the loss is slight, in others it is distinct, and in many it is severe.

Chief emphasis is placed upon streptococcic mastitis, because this is by far the most prevalent form. While other kinds of infection are found, control of the streptococcic form virtually checks the disease.

Mastitis is a chronic infectious disease characterized by recurrent acute attacks that tend to appear when the cow is drying off, shortly after she freshens, when she is fed heavily on a high-protein diet, or when she is otherwise exposed to unusual strain. If the disease is acutely active, the milk is changed in appearance; it may become watery, or serous, or merely contain flakes or flocculi, as observed when the strip cup is used. The anatomical changes in the udder are in the form of a connective-tissue thickening, a fibrosis, that gradually replaces the grandular structure, and that can be recognized easily as an indurated, firm mass when the udder is flaccid and thoroughly milked out.

While there are many forms of streptococci, those causing the usual type of mastitis constitute only a small group. Thus the disease is almost as specific as tuberculosis or abortion. But there is one important difference: when the tubercle bacillus is eliminated from a herd, it is impossible for the disease to develop without introducing new infection from the outside, but streptococci capable of causing mastitis are always present in the stable. They are ubiquitous and ready to operate whenever conditions are favorable. Mastitis streptococci are not commonly pathogenic to man, and according to Seelemann they may not be destroyed by pasteurization at 85° C.

It requires only a little study

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to discover how mastitis may be eradicated and prevented in any herd. Under ordinary circumstances mastitis does not spread rapidly, and, if well-known precautions are taken, the infected cows may remain in the herd without great danger to the non-infected. As farmers learn of the possibility of having mastitis-free herds they will utilize this knowledge, but the program can be made highly effective only by the direction of one skilled in an examination of the udder.

With these facts in mind the authors have studied a group of eight herds comprising about 300 cows. The methods of examination included the microscopic appearance of the milk; the alkalinity of the milk as determined by colorimetric tests, using phenol red and bromthymol blue, "thybromol"; bacteriological examination, chiefly on blood agar plates; and physical examination of the udder, including the milk production.

In making a survey of a herd, the first part of the examination is conducted before the cows are milked. This includes an examination of the gross appearance of the milk, tests for alkalinity, and collection of samples for culturing on blood agar plates. Physical examinaton of the udders is made directly after milking.

Strip cups are in common use in certified herds, and they have been adopted to some extent by others where mastitis control measures are in operation.. This cup, or sieve, consists of a pint tin cup or a larger tin receptacle, which is fitted with a removable top. One-half of the bottom of this section is made of fine wire mesh, 100 squares to the inch, the other half is made of tin. Fine black cloth may be used instead of the wire mesh. The strip-up test is made by drawing the first one or two streams from each teat directly onto the sieve, and examining the sieve for flakes or clots. In a careful test for mastitis the top of the cup should be removed and the sieve rinsed in water after each test, to remove the thin layer of foam that may obscure a slight flakiness in the milk.

The routine use of the strip cup is of great value in detecting the very first stage of an acute inflammation, whether it be an initial attack or a "flare-up" of a permanently diseased udder. The presence of flakes on the sieve is reported to be frequent in cows affected with a form of mastitis so mild that changes in the udder are not recognized by a physical examination; it is merely a catarrh of the musoca of the milk cystern and lactiferous ducts and its known as catarrhal mastitis.

The authors believe that in many instances this flakiness of the milk indicates a mild "flare-

up," or increased activity, in the course of a chronic streptococci mastitis, and that such a condition may be found by means of a thorough physical examination. A single survey of a herd with a strip cup for the purpose of detecting cows affected with mastitis is not of great value. Flakes or clots may be found in some of the advanced forms, but such animals are readily found by other means. A large proportion of the cows distinctly affected with chronic mastitis give milk that is usually free from flakes and clots; these appear only when the condition becomes active. Milk may also present a change in color and consistency; it may be watery or lighter in color, or yellowish, and such milk may be free from flakes, as shown on the strip cup. This color change may be recognized by a comparison of the affected milk with normal milk, either in test tubes or by pouring a small stream into a shallow pool of normal milk on a flat surface, as in a saucer.

Milk from cows affected with chronic mastitis is usually alkaline in reaction and salty in taste; in many instances this change may be recognized by merely tasting the milk. In recent years, however, various accurate colorimetric tests have been introduced.

Solutions of bromthymol blue and phenol red have been used by the authors as a part of the routine method of examination, and they are convinced that either one is of great value in the diagnosis of mastitis.

Bromthymol blue is slightly more sensitive than phenol red, and in inexperienced hands it may lead to an occasional error. Its simplicity, on the other hand, gives it preference for testing milk in the stable. One gram of the bromthymol-blue powder is dissolved in 500 cubic centimeters of 47.5 per cent alcohol. To adjust it to a more alkaline range, it is necessary to add about 1.5 cubic centimeters of a 5 per cent sodium hydroxide solution. If this prove to be too much, the addition of a few drops of a 5 per cent solution of hydrochloric or sulphuric acid brings it back to the neutral range. It is important that this indicator be only slightly alkaline or slightly acid. An acid bromthymol-blue solution is red, while an alkaline solution is green. If the solution is too acid, it may not give a distinct green in alkaline milk; if it is too alkaline, it may impart a green color to normal milk.

Milk from cows that have recently freshened or that are nearly dry is not suitable for the bromthymol-blue test, since it may be alkaline and give a color reaction where mastitis is not present. Milk for examination is drawn after discarding the first

four or five streams—that which is drawn into the strip cup. Then from each teat to be tested 5 cubic centimeters of milk is drawn into a test tube and examined for any difference in color or consistency. Milk from the different teats of an udder should be identical in appeaarnce; variations in color or consistency indicate an abnormal condition. A slightly watery or discolored milk is easily recognized if the comparison is made in good light. The test is made by adding 1.0 cubic centimeter of the indicator to 5 cubic centimeters of milk. Normal milk gives a slightly yellowish green or greenish yellow color. Milk having a pH of more than normal, 6.2 to 6.5, usually turns green. It is frequently observed, however, that milk from a diseased quarter giving a pH of 6.46 with phenol red may turn dark green with bromthymol blue, and that milk giving a pH of 6.66 with phenol red may turn green or remain normal when bromthymol blue is added. In diseased quarters there is often considerable variation in the reaction from time to time, depending apparently on the activity of the inflammation. But a study of the case reports shows that milk giving a green reaction invariably comes from a quarter in which indurations are found on physical examination. If the alkalinity is only slightly above normal, the color is light green, but with an increasing alkalinity it is distinctly green to very dark green.

In the authors' experience bromthymol blue has proved to be a highly reliable test for the diagnosis of chronic mastitis. With the exception of a physical examination it reveals a higher proportion of disease than any other single method. In mastitis-free herds and cows, reactions do not occur, with the exception of an occasional light green that should be disregarded unless other evidence is found.

In no disease has a bacteriological examination of a secretion received such exclusive diagnostic importance as that given to milk in relation to mastitis. It is quite generally accepted as the standard by which all other methods of examination are judged. But the authors have found that as high as 20 per cent of chronic mastitis in a single herd, as shown by the pH test, the physical examination and the strip-cup test, may fail to reveal bacteria from milk on blood agar plates on one examination only.

In the eight herds under examination, comprising from 250 to 300 cows, bacteriological examination of the milk from each cow has been made repeatedly. The udder is wiped with a cloth moistened with alcohol, and the milk is collected in sterile glass shell vials. In a large proportion

of the cases of mastitis the streptococcus has been isolated. In a number of instances cultures from physically changed cases of active mastitis have been sterile, but as a rule bacteria have been obtained at a later period when the animal was classed as "recovered." Reference has been made to the negative finding on blood agar plates cultured with milk udders affected with advanced chronic mastitis. This is probably explained by the presence of an inactive condition at the time the sample was taken.

As a rule, however, the findings on the blood agar plates agree with the results of the pH tests and the physical examinations. Perhaps the most unexpected result of the authors' experience has been the ability to recognize mastitis by means of physical examination of the udder and chemical examination of the milk in nearly every cow whose milk was positive on the blood agar plate. If this experience applies generally, the diagnosis in mastitis control is not difficult.

The value of a physical examination in diagnosis rates above any other single method. While it perhaps is true that a negative bacteriological examination is an indication of the absence of bacteria from the sample, it is not positive assurance that the udder supplying the sample is not diseased, nor that it will not soon be eliminating streptococci. A physcial examination, on the other hand, has revealed pathological changes in the udder more uniformly and certainly than has any other single method employed. Because of the nature of the tissue changes, fibrosis, one would naturally expect to find a distinct difference between the normal flaccid glandular tissue and the firm indurated connective tissue.

A physical examination is best conducted directly after milking. When the udder is distended with milk, or when it is congested and swollen before and after freshening, the elasticity of the glandular tissue cannot be felt. The examiner must consider the age of the cow, the date of last calving, and the date of conception in pregnant cows, as well as the herd history with respect to mastitis and the position of advance cases in relation to other cows in the herd. He should learn, if possible, whether the cow under examination has had one or more attacks, whether she is a "short milker," and what her daily and yearly milk and fat production are.

Observe the symmetry of the udder. Lift up each quarter with both hands, noting the size, weight and consistency, and compare these three with the findings in each of the other quarters. When a difference in the size of the quarters is found, as one

large and soft and one small, firm, front quarter, the smaller one may have been affected with an acute mastitis that caused suspension of the milk flow and shrinkage of the glandular tissue, but the degree of inflammatory change may be determined only by its activity during subsequent lactation periods. If the smaller quarter is found to be distinctly nodular, however, instead of smooth and regular on the surface, one may conclude that connective tissue has replaced the glandular tissue; it has become indurated. During the active stage of an inflammatory process, an affected quarter may be considerably larger than its mate, for example, one hind quarter is decidedly larger than the other, and doubt exists as to whether one is swollen and indurated to a pathological degree or whether the other is atrophied to a pathological degree. As a rule, the question is easily answered by the presence of irregular indurations. But occasionally there is doubt, and a decision may be reached by means of the colorimetric test. It is self-evident that long practice in the palpation of udders brings increased skill.

Apply superficial palpation to the surface of the quarter. Each quarter may be normally smooth or lobulated. A normal lobulated surface is uniform in contour and the projections are small and regular, while a pathological lobulation is not uniformly distributed and the lobules are not uniform in size.

Apply deep palpation by again lifting up each quarter and kneading forcibly into the depths of all parts to detect circumscribed or diffuse indurations, and to recognize the elasticity and pliability of the normal glandular tissue.

Individual quarters are classified as "—" (negative), entirely normal; "s," single indurations not more than 1 to 2 inches in diameter; "d," multiple slight indurations or a single induration approximately 2 to 3 inches in diameter; "m," disseminated or diffuse extensive indurations that have largely replaced the glandular tissue.

There has been little systematic effort to prevent or control mastitis except in herds producing certified milk. Two chief methods have been employed; namely, sanitation and vaccination. Many persons have reported the results of vaccination, and vaccines are being used widely both for prevention and cure. The published reports on the effect of vaccines are widely conflicting, and their value has yet to be proved. All writers agree, however, that the success of any method of control depends on good hygiene, and there is plenty of evidence that this alone

is sufficient to control and even to eliminate the disease.

Certain municipalities require an annual physical examination of the udders of cows supplying their milk, and this has eliminated many badly diseased quarters. In like manner, large milk distributors systematically inspect the cows and stables, and require definite standards for the housing and health of animals supplying their product. But there is need of a more thorough program to maintain mastitis-free herds. This is entirely within the range of possibility; it will lower the cost and improve the quality of the product.

The first requirement for sanitary handling of the udder is a properly constructed stall for the cow. The minimum requirements are adequate space, stall partitions to prevent cows from treading on teats, and a well-bedded dry floor. The use of land plaster or hydrated lime on the floors, gutters, and the back part of the stall beds is desirable; it absorbs moisture and is a mild antiseptic.

In the assignment of stanchions all affected cows should be placed in a single group, to prevent close contact with mastitis-free animals, especially the heifers. It is probably that infection spreads most readily from advanced and active forms, but all cows with indurations in the udders should be kept out of the mastitis-free group, regardless of the history or the appearance of the milk. This may be difficult to accomplish when an owner is not convinced that a favorite cow is abnormal. The spread of infection from one animal to another is only gradual under usual conditions, but finally it reaches a point in many stables where 50 per cent or more of the udders show distinct or marked indurations and the herd is badly damaged.

According to the best evidence infection occurs during milking. It is brought to the ends of the teats on the hands of the milker, or the cups of the milking machine. Injuries, rough manipulation, and incomplete milking, all contribute their quota, but this transfer of infection from the diseased to the normal animal at milking time is held by most observers to be of chief importance in the spread. Precaution at this time constitutes the most effective method of control. In the experience of the authors mastitis spreads less readily in herds that are milked by hand than in those milked by a machine, for the milking is probably more thorough and better adapted to individual cow requirements. Before passing from one cow to another the milkers' hands should be washed in warm soapy water and dried. If milking machines are used, the cups may be rinsed

in a chlorine disinfectant after each cow has been milked. After milking, the ends of the teats should be dipped in a similar solution containing from 400 to 500 parts of available chlorine per million, or a solution of creolin (from 2 to 3 per cent). In certified herds, udders are washed and disinfected before milking. This is an aid in the prevention of mastitis if the udders are dried to prevent chilling in cold weather, and if the wash cloths are kept clean. The use of a single cloth to wipe or wash a number of udders repeatedly may serve as a carrier of infection. The use of a strip cup informs the milker of acute cases and of recurrent activity in time to avoid the spread of infection to other cows.

The principles involved in the practice of sanitary milking, identification of mastitis, and segregation of the sound from the diseased cows are simple. But their adoption and application require an intelligent and interested farmer, as well as a skilled and experienced veterinarian.

Results in Feeding Molasses Silage

Condensed from Certified Milk

C. B. Bender, Ph.D.

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IN its essentials, the molasses method of ensiling crops is the means whereby legumes and grasses may be preserved without regard to inclement weather. The addition of molasses to the chopped green material as it is blown into the silo brings about a desirable bacterial action for the production of lactic and acetic acid which preserves the material.

Our experimental results have shown that forty pounds of molasses per ton is sufficient for the preservation of grasses and cereals. Sixty pounds will preserve mixed grasses and legumes. Alfalfa and clover need seventy-five pounds and soybeans should receive one hundred pounds of molasses per ton.

The material should be ensiled when it is high in moisture. When the moisture content of the material is high, our experimental results have shown that all the carotene in the green material is preserved. When the material is ensiled at a low moisture content,

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as much as 30 percent of the carotene will be lost by oxidation.

During this past winter, experimental feeding trials were conducted at the North Branch of the N. J. Experimental Station to determine the comparative value of molasses grass silage when fed to milking cows. Four groups of cows were used on a progressive reversal experiment. The roughages used were as follows:

Grass silage and hay
Corn silage and hay
Grass silage alone
Grass silage and corn silage

Each group of cows was fed a particular roughage for a period of three weeks and then changed to the next roughage group after a transition period of one week. The production of the animals receiving grass silage and hay as the only roughage was 36.84 pounds of milk per day on twice-a-day milking and the grain ratio was 1:4. The animals fed grass silage alone produced 36.04 pounds of milk a day. The animals in the corn silage and hay group produced 36.44 pounds of milk while the animals fed grass silage and corn silage produced 35.2 pounds of milk a day.

The silage used in this experiment was composed of 10% alfalfa, 30% clover and 60% timothy. The hay used was dehydrated and made from the same type of material. It was found that the animals fed on grass silage alone or on grass silage and corn silage had difficulty in consuming the amount of material necessary to meet the calculated dry matter intake requirements. To meet these requirements in some cases it was necessary to feed as high as ninety pounds a day of the roughage. As a result of this experiment, it is felt that grass silage and a minimum of hay is an ideal roughage for the production of milk. It was furthermore felt that if a better quality of silage had been used, namely, one that contained a higher percentage of the legumes, the production level would have been higher and it might have been possible to reduce the protein level of the grain ration.

Another experiment was undertaken to determine the growth response of Holstein and Guernsey heifers on a sole ration of either molasses silage or molasses silage and dehydrated hay. As a result of the last two winters' experience on these rations it was found that the Holsteins averaged .86 pounds of gain a day; while the Guernseys gained .6 of a pound. During the length of the winter feeding trial the average height gains of the Holsteins was 5.5 while the Guernseys gained 4.9 centimenters. In heart girth the Holsteins averaged 6.5 and the Guernseys 5.6 centimeters for the same period.

For the duration of the feeding periods it was found that the gains in height were slightly better than Ragsdale's normal standards. The intake of grass silage varied between 38.5 and 52 pounds. The intake varied with the age and size of the animals. Animals in these experimental groups were from ten months to twenty months of age. In connection with this feeding trial it was found that the heifers fed grass silage and a minimum of hay made slightly better weight gains. This was brought about by the increase in the total nutrients consumed. Timothy silage was used for the heifer feeding experiperiments.

The grass silage used in this experiment cost us $4.60 a ton, so that our costs for raising these heifers during the winter months were held to a minimum.

Another feeding trial conducted during this past winter was to study the color and flavor of milk produced by Guernsey cows when fed on various types of roughage. As a result of this study it was found that the color was maintained more uniformly in the groups receiving grass silage as part or all their roughage. The roughage ration which contains a high proportion of good quality molasses silage is superior to corn silage in its ability to produce milk of a high color and flavor.

Grasshoppers and Turkeys

Condensed from Turkey World

THERE are a number of practical problems in connection with grasshoppers and turkeys. Do grasshoppers have any food value for turkeys? If they have any food value, what management program should be followed when grasshoppers constitute a part of the diet? Do grasshoppers have any harmful effect on turkeys? Will the grasshopper diet result in a poor quality market bird?

Probably the only experimental work ever done on this problem was done in 1936 at the Oklahoma station. Analyses show that freshly killed grasshoppers contained 68.7 percent water and 22.6 percent protein. Dried grasshoppers contained 72.15 percent protein.

Several hundred pounds of grasshoppers were caught, killed, dried, and ground into a relatively fine powder. Three lots of six

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weeks old poults were used in the experiment. Lot 1 was fed a test ration. Lot 2 was fed a ration containing 8 percent grasshopper meal, and lot 3 a ration containing 16 percent grasshopper meal.

Poults in lot 2 made fair gains, but less than lot 1. Poults in lot 3 were very unthrifty and mortality was so great that after two weeks they were placed on the same ration as lot 1. The general conclusion was that although grasshoppers contain relatively high percentages of protein, they are not a good feed for turkeys. The work is being continued in an effort to determine more definitely the value of grasshoppers in turkey feeding.

It is a well established fact that turkeys are quite valuable as hopper exterminators and that they have been widely used for this purpose. It might be noted here, however, that in order to be most effective, the turkeys should be started early in order to destroy the hoppers while they are in the small or non-migratory stage.

Turkeys produced on a grasshopper diet are usually of poor market quality and the grade of the bird is lowered in direct proportion to the extent that grasshoppers are used in the diet. Gains on grasshopper diet will vary accordingly. The poor quality and the decrease in gains resulting from a grasshopper diet are due to several different factors.

The skeleton of grasshoppers is made up of a tough, horny substance called chitin, which cannot be dissolved by digestive fluids. The legs, wings, and other hard body parts tends to accumulate in the digestive tract, particularly in the crop, and in flocks depending upon grasshoppers as a major part of their feed, death losses from crop or intestinal impactions are common.

While grasshoppers do have some feeding value, the physical exertion involved in "running them down" neutralizes this value to a great extent. Also, turkeys that spend most of their time "hopper chasing" develop tough, stringy muscles.

It is also true that heavier mortality occurs in flocks on heavy grasshopper diets. This is due largely to the weakening effect that the grasshopper diet has on the birds. It may also be due to the fact that grasshoppers serve as intermediate hosts for several species of tapeworms known to affect turkeys.

On the other hand, it must be taken into consideration that grasshoppers contain some protein and have some feeding value for turkeys. It must also be considered that in some regions grasshopper extermination may be as important, if not more im-

portant than the production of high quality market birds.

Since these facts are true, the management program followed will depend upon which is most important — hopper destruction or the production of quality birds.

If the production of high quality birds that will give the grower a profit is of first importance, then grasshoppers as a feed should be incidental to a complete feeding program. A complete ration of grain and mash should be supplied. The birds can, in this way, balance their own ration by eating at will of hoppers, grain, mash and any other feeds supplied. If the feeders are moved to a new location daily, the birds will follow them and, in this way, a greater area can be covered and more hoppers consumed. The grasshoppers consumed under such a program should not greatly affect the growth and development of the birds.

When grasshopper destruction is of greatest importance, the flock is usually herded over the fields. The birds are allowed to eat grain, and in some instances, mash in the mornings and evenings. Under such a program the farmer must expect heavy mortality losses, poorly developed birds with tough, stringy flesh. This may be made up for by somewhat cheaper gains and by destruction of hoppers.

Drowning the Drought

Condensed from The Indiana Farmer's Guide

C. E. Hughes

WITH growing concern Sanford Fletcher watched the ever-increasing drought of 1936. The dry years of 1930 and 1934 had not been particularly bountiful for fruit growers, and 1936 was heading for new records.

Fletcher is an orchardist, but, with the exception of a small plantation he owns no trees himself. Instead, he manages orchards for other farmers on a custom basis, performing such operations as pruning, spraying, fertilizing, thinning and harvestng for an agreed share of the crop.

Orcharding made him a living —yet Nature was doing her best to burn him out. Sky gazing brought no relief. He found that out in 1934 and hauled water in

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tanks to his trees. Hauling was inconvenient and none too satisfactory. Yet there was water right beneath those trees waiting for him to come down after it.

During the first week of July last year Fletcher selected one end of a 6-acre archard and drilled two wells 16 feet apart. He struck water at 18 feet and sunk a 4-inch well pipe in each boring. By setting up an 80-gallon pump midway between the wells he was able to secure a flow of 50 gallons a minute. Three hundred feet of 2-inch pipe were used to carry the water out through the orchard. Movement among trees was facilitated by attaching 150 feet of ordinary fire hose to the end of the pipe.

He kept expense records from the outset. Besides that, he put his irrigation enterprise on an experimental basis. Selecting a block of 170 Delicious apple trees he watered 108 of the group, skipping one here and there and tagging the unwatered trees for future comparison. By watering 18 trees a day he made the rounds in one week's time.

Eleven days later Fletcher irrigated 80 trees and marked the ones that received the first watering but none the second time. Again each tree received 1,000 gallons. On the 24th day he watered 62 of the remaining 80, applying but 600 gallons to each tree.

On August 18, Prof. C. E. Baker, of the Purdue horticulture department, visited Fletcher's project and took soil moisture tests for the various types of water treatments. Soil moisture content ranged from 9.6 per cent for unwatered trees to 24 per cent for others receiving the maximum application of 2,600 gallons. From the increased size of fruit and the improved vigor and foliage of the irrigated trees it was quite apparent that water was doing its work.

But Fletcher was even more interested in the end product—marketable apples. On October 1, with the co-operation of Professor Baker, fruit was picked from the experimental plot. Selecting the southeast section of each tree, the fruit was picked from the lowest limbs to the very top. The apples were measured off into bushels and counted with the following results.

Kind of Treatment	Apples per 48-lb. Bu.	Increase in Size
Unwatered	221	
One Application (1,000 gallons)	149	46.3%
Two Applications (2,000 gallons)	134	64.2%
Three Applications (2,600 gallons)	130	70.0%

From the preceding table the added benefits of watering for increased size of fruit can be noted readily. For total production, watered trees averaged almost half again as much as the ones that went dry. Furthermore, the color and attractiveness of the fruit were enhanced greatly by irrigation. "San" received 50 cents a bushel more for apples from his watered trees.

Fletcher's experiment was not expensive. It cost $41 to drill the wells; the pump added $40; and gasoline and miscellaneous items amounted to $5.92. Similar operations on a larger scale would call for greater overhead expense but any farmer could well afford to install similar equipment.

Otato

Condensed from The Western Farm Life

Iva Wilson

OTATO meal or flour is used for baking purposes and large quantities are sold to bakeries throughout the country. The process was worked out in a laboratory in New Jersey, and the first mill was located in the heart of the productive potato belt in south Idaho, so that cull potatoes might be utilized. The strict grading law of the state prohibits the shipping of this grade, and the mill brings to the producers an outlet for that part of the crop that had been found only of doubtful value as stock feed.

The process is simplicity itself. The tubers are carried on an endless belt from the storage cellars to the "squirrel cage," a huge galvanized cylinder having a screw lining which keeps the potatoes moving through the water that is sprayed upon them through their progress.

Emerging from the bath, they are dropped upon a metal belt which carries them through the cooker. This is a steam chest about 25 feet long inclined at an angle of 45 degrees to the floor. It is well insulated and held at a temperature high enough to cook potatoes as they travel slowly through it.

Reaching the upper end of the cooker, they are dropped into the

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extruding machine which takes off the skins. The mealy interiors of the potatoes are pressed through the openings of a cylindrical screen, and drop into shining metal tanks where automatically operated paddles stir it with water until it is the consistency of cream soup. Lifted by pumps, this liquid is passed through screens of small and yet smaller meshes until it becomes perfectly smooth and is called slurr. Over one corner of the building stands the tower—a round, concrete stucture 70 feet high and heated to a high temperature by great crude-oil burners roaring in its base. Into the tower the "slurr" is sprayed. Its moisture is instantly evaporated in the heat-charged atmosphere and it falls as "Otato" into the receptacles provided for it. It is packed for shipment in bags, like flour.

Samples submitted for trial to many food manufacturers brought instant approval. Bakers and preserved meat manufacturers saw in it an available and cheap product. It is perfectly fitted to meet the conditions of the export trade. Dampness does not induce mold, and temperatures, high or low, have no adverse effect. It will meet the needs of cold countries where potatoes in their natural state cannot be kept from freezing, and of hot countries where they cannot be kept from spoilage.

Fifty Years of Breeding Cherries

Condensed from Farm Research

G. H. Howe

FOR more than 50 years the Experiment Station, at Geneva, N. Y. has been carrying on selective breeding work with hardy fruits. And the introduction of a single seedling, Seneca, in 1924, was a notable contribution to the varieties of cherries.

At the close of 1936, there had been originated at the Station 1,525 cherry seedlings. Of this number, 1,213 seedlings have been planted in the orchards and some four or five hundred have fruited. Of these only one other seedling besides Seneca has been named and introduced. Several others now appear promising and may be worthy of introduction later.

In Seneca, fruit growers have come to possess a very early-ripening sweet cherry of exceptional merit. No other cherry now known ripens its fruit so early. Senecas are ready to pick in the first weeks in June, more than two weeks ahead of Black Tartarian. The cherries resemble Black Tartarian in every character and are equally as good in quality. They are about as large, of the same color and appearance, and the soft-fleshed fruits are just as sweet and delicious as those of the older sort. For local and roadside markets Seneca is unsurpassed.

Seneca has one serious drawback. Thieving birds relish the luscious glossy black fruits as well as do humans! Unless the trees are protected it is sometimes difficult to harvest a crop. If there is a sizable planting of Senecas then there seems to be a sufficient crop for both birds and man.

Altho the breeding of cherries at the Station has not resulted in the introduction of many new kinds, the Station has tested and fruited several noteworthy varieties, old and new, from other sources. Some of these have proved to be so good that they have been recommended to the New York State Fruit Testing Association for introduction, and that Association is now offering quite a collection of meritorious sorts covering a long cherry season.

The next variety to ripen after Seneca, is Early Rivers, an old English sort. The fruits are large, handsome crimson black, excel-

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lent in quality, and are considerably firmer in flesh than other early-ripening cherries. Early Rivers is worthy of culture by all growers of sweet cherries.

The third dark-colored sweet cherry ripening midway between Seneca and Black Tartarian is Lyons, known and esteemed for more than a century in Europe. Curiously enough, it never seems to have been disseminated in America while many other European and American sorts of much less value have been widely planted. Not until the Station recommended Lyons to the Fruit Testing Association was the variety known in New York. Lyons now seems to be finding favor among a large number of cherry growers. It is one of the largest of the early cherries. The fruits are purplish black, soft-fleshed, good in quality, altho not as highly flavored as either Seneca or Early Rivers. The trees are very large and prodigiously productive so that the roadside stand can be amply supplied with these attractive fruits from a small number of trees.

After the season of Black Tartarians there follow, along with good black sorts, a number of superior light-colored kinds as well.

Victor, is a Canadian seedling which orignated at the Vineland Experiment Station in 1916. These cherries are large, firm-fleshed, and of excellent quality. The variety is no better than Napoleon, but it does fill a season a little ahead of that well-known standard of excellence.

Emperor Francis, is a century-old European variety apparently never disseminated in this country until it was recommended after several years of fruiting at this Station. For a cherry of the Napoleon type to precede that sort immediately, Emperor Francis leads all others. It is as large as Napoleon, less conical, and better in quality. The color of the two is similar except that Emperor Francis is a little more red, less mottled, and becomes darker at full maturity. For the making of maraschino cherries, Emperor Francis seems to be as satisfactory as Napoleon. The season is two to three days ahead of Napoleon and the fruit holds well to the tree without undue cracking.

The second cherry which originated at the Experiment Station as a result of selective breeding is another black sweet which gives promise of replacing the well-known Schmidt, a splendid cherry in quality but one with many faults. The new variety has been named "Gil Peck" in honor of the late Professor Gilbert W. Peck.

The cherries can be described as large, dark colored, firm fleshed, juicy, and good in qual-

ity.The season is about with Schmidt, and fully a week ahead of Giant. If the tree and fruit character hold up, Gil Peck is almost certain to replace Schmidt in popularity.

These comments on Gil Peck lead us next to a brief account of the merits of Giant, one of its parents. Giant is one of Luther Burbank's numerous plant introductions of more than 25 years ago. Widely disseminated on the Pacific Coast the variety has become the standard of excellence in that region and lately seems to be gaining favor with eastern cherry growers. In appearence and quality it is one of the best of the purplish black, firm fleshed sweet cherries. The richly flavored fruits are considerably less subject to cracking than those of Bing, a fault which all but condemns the culture of that otherwise superior variety.

Mention must be made of another European variety known as Geant d'Hedelfingen which from its performance at the Station and in Canada justifies its being recommended as a large, firm-fleshed, late black cherry of the type of Lambert. The fruit has the valuable attribute of not cracking and for this reason it may come to replace Lambert in eastern cherry orchards. This newly introduced variety along with Gil Peck and Giant may in time constitute the three outstanding dark-colored commercial shipping varieties for eastern cherry growers.

There is a class of cherries which deserves more recognition on the part of cherry growers than it now receives. Reference is made to a group of hybrids between the sweet and sour cherries known as the Duke cherries. These Dukes can be described as having characters of tree and fruit midway between the sweets and sours. The trees are more upright than those of the sour cherries, yet not wide spreading like those of the sweets and the foliage is also midway between the two in size and appearence. The fruit has more of the external appearence of the sour cherry but is milder in flavor, having a most refreshing mildly piquant tartness.

Of all the Dukes, the one which merits the attention of fruit growers is Royal Duke, a variety long esteemed in Europe. The trees are hardy and healthy and are the largest and most productive of all the Duke varieties. The cherries are large, handsome bright red, full of refreshing juice and pleasantly flavored. They can be relished by everyone for eating out of hand and for all culinary purposes, they are unsurpassed. Once tried, the variety will be eagerly sought by patrons of roadside and local markets.

The standard sour cherry still

is the Montmorency and this variety probably will continue to be the standard for sometime unless cherry breeders succeed in bringing forth an improvement on it.

Two sports of Montmorency have recently been introduced which may prove to have considerable value in prolonging the season of Montmorency for the cannng trade. These are Montearly and Montlate, the one, as its name indicates, ripening 10 days or two weeks ahead of its parent and the other extending the Montmorency season by the same length of time. Aside from the variation in the season of ripening there seems to be little difference between the tree and fruit of these sports and the parent variety.

All sweet cherries and all Dukes must be cross fertilized. There are, too, four leading sweet cherries which are inter-sterile, namely, Emperor Francis, Napoleon, Bing, and Lambert. Some other sweet cherry should always be planted with these varieties in order to insure a crop.

Mazzard and Mahaleb have long been the standard stocks on which cherries are propagated. Prolonged experiments at this Station and elsewhere have proved conclusively to the Station fruit specialists that Mazzard is the better understock for all varieties of cherries. Those who propose to plant the varieties herein described will profit by procuring trees which have been budded on the Mazzard root. This understock will insure larger, healthier, longer-lived, and more productive trees than will be the case if Mahaleb is used as a stock.

Evolution of the Horse Shoe

Condensed from The Rider and Driver

THERE are three distinct epochs in the history of the horseshoe. The first is by far the longest, extending from approximately 500 B. C. down to about 1880 A. D. This was the epoch of the hand turned iron shoe. The second epoch—that of mass production, machine manufacture of horseshoes—runs from about 1880 to the present. The third epoch—that of the rubber covered horseshoe—is only some two years old but already it promises to equal or out-weigh the other two in importance.

To obtain the proper perspective on this subject, however, we shall have to turn back the pages of history fully 2,500 years to the era when horseshoes first are known to have existed. It is a highly significant fact that, 2,500 years after horseshoes were first invented by man, improvements should still be possible which portend revolutionary changes in this ancient art.

The solid hoof-cased foot of the horse, under natural conditions is sufficient to protect the extremity of the horse's limb but when the animal is tamed and made to work, the hoof tends to wear and break. That this fact was recognized hundreds of years before Christ is shown by the finding of iron horseshoes fastened with iron nails in the roads used by the Celts in the 5th or 6th century B. C.

The blacksmiths of those ancient days generally were the priests and the learned men—known as Druids. These "advanced thinkers" of their day frequently lived in caves and rock enclosures and worked secretly at their forges.

A complete Celtic forge has been found in acient Gaul, in the region of Alesia. In the debris covering the floor, with the forge, were cinders, charcoal, calcined bones of men and horses, a triangular file, a thick flat file, a small chisel, iron cinders, bronze castings, a large iron hammer weighing five pounds, an iron buckle, a fragment of a horseshoe, a long flat nail, and a blade of a long knife.

The use of iron for the protection of horses' hoofs apparently declined among the Greeks and early Romans. They are believed to have preferred sandals, boots and socks of leather, fiber and coarse cloth fastened with straps or thongs. In some instances

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plates of metal were placed inside such coverings. In the later period of the Roman era, however, the Romans learned about the use of iron horseshoes and nails from other Europeans.

During the "Dark Ages" records were destroyed which might have shown the progress made in the use of horseshoes. Later, as history began to be recorded again, we find that the smith has become one of the central figures of the community, making not only horseshoes but spears, swords, lances, armor, farm implements, kitchen equipment and other household articles. Frequently the smith became a powerful noble, second in power and privilege only to the king.

Anglo-Saxon priests were musicians, ironsmiths, goldsmiths, and handicraftsmen combined. St. Eloy, a popular saint among horsemen during the Middle Ages, is frequently spoken of as a goldsmith but in mediaeval drawings he is most commonly shown shoeing horses. Many smiths were not alone the metalworkers and horseshoers, but feudal lords placed them in charge of their horses, and gave them command of the horsemen of the guard.

The first mention of iron horseshoes and nails after the "Dark Ages" is in the "Tactica" of the Eastern Emperor, Leo VI (A. D. 886-911). It includes a list of everything needed by a cavalry soldier including crescent-shaped iron shoes and nails.

Gradually, as knowledge of the connection between the proper shoeing methods and the power and utility of the horse became widespread, the animal began to be used for draft purposes in addition to carrying riders. In the early 13th and 14th centuries, horseshoes were made by the village smith from iron purchased by the Chief bailif. Most of the shoes of this period were light, weighing not more than a half pound each. Iron horseshoes were sold by the hundred and nails by the thousands at fairs in England as early as 1265.

Sheep's horn was used for horseshoes in Iceland while in other out-of-the-way areas stag horn shoes and stag horn nails have been used. The camels of Mongolia sometimes are given sheepskin shoes by their Tartar owners. Cattle hide is also used in winter. Curious iron sandals, called hipposandals, have been dug up with Roman, Gallo Roman and Frankish grave ruins in France, Belgium, Germany, Switzerland and England.

Iron horseshoe making today is a thoroughly modern process and despite the motor age, constitutes an important industry. As in other industries, modern methods have produced a better product at lower cost. Contrary to general belief the coming of

the motor has not eliminated the market for horseshoes. According to United States Government statistics, there are more than seventeen million horses and mules in use in this country today.

The hand-turned horseshoe is definitely a thing of the past; it has given way to the factory made article. The end of the hand made horseshoe epoch was in sight when in 1882 a horseshoe business was begun which since is claimed to have grown to be the largest in the world. In that year the Phoenix Horse Shoe Company commenced operations in Hartford, Conn.

The manufacture of iron horseshoes begins with billets which are heated, rolled into bars, notched and cut to length to form blanks. In this form the shoe reaches the blacksmith shop where the smith re-heats it and modifies its shape somewhat to conform with the foot of each particular horse.

Such was the status of the horseshoe manufacturing industry up to the last few years when experiments were begun to develop a rubber covered shoe which might utilize the recently discovered process of applying rubber to metal.

The method is known in the trade as brass plating. It first came into use about 1925, since which time substantial improvements have been made in the method. Briefly described, the drop forged steel shoe insert when received from the foundry is scrupulously cleaned, then sand-blasted, after which it is brass plated. The clean brass plated surface is immediately protected by a heavy coating of rubber cement which also serves the purpose of securing adhesion between the metal insert and the rubber compound. Brass plating must be done with great exactitude. Permanent adhesion of metal to rubber has been finally achieved.

There were several reasons for the horseshoe industry being interested in the possibilities of rubber covered shoes. In the first place, it was believed that such shoes would be as important to the horse in reducing fatigue from jar as rubber heels have been to the human. Then, too, it was believed that the weight of the shoe could be reduced, its wearing qualities might be increased and its cost materially cut down. But of equal importance, perhaps, was the contribution such shoes might make to the growing demand for silent delivery equipment on the streets of our large cities.

The Borden Company is one of the largest users of horses in the country, maintenance costs on such items as grain, hay and straw, amounting to more than $1,000,000 annually. The Com-

pany has carried on experiments of its own with rubber covered horseshoes made according to its own design and specifications.

Within the last six months, William P. Kearney of the Transportation Bureau of the Borden Company, who has been doing the noise-silencing experimental work for the company has applied for patents on a rubber covered horseshoe which is believed to be a distinct improvement over any such shoe developed to date.

The principle on which this latest shoe is based is squee-gee coupled with the natural traction provided by deep sharp edged transverse cuts in the rubber shoe itself. These cuts form retangular lugs in the bottom of the shoe which afford good traction and prevent slipping and skidding on wet or icy pavements.

Tests made last winter on icy streets showed that these new shoes provided at least as much traction as any of the old-fashioned winter shoes requiring drive calks or screw calks, the elimination of which will be a boon to horses which have heretofore required these crude attachments in order to operate on slippery streets in winter.

The belief of the early experimenters in the advanages of rubber covered horseshoes has been amply fulfilled. The weight of the shoes has been reduced to about one-half; the cost is much less; the horse's grip is much firmer than is possible with iron shoes and the useful life of the horse has been extended from two to three years.

Using Salt to Regulate Grazing

Condensed from The Hereford Journal

W. W. Weir

Southwestern Forest and Range Experiment Station, U. S. Forest Service

FROM studies pertaining to the utilization of range forage, the Southwestern Forest and Range Experiment Station has demonstrated that judicious use of salt and proper location of earth tanks can make possible not only the use of forage farther out from waters but also its conservative and economic utilization over the range as a whole. This applies especially to semi-desert grasslands.

The range problems that led to these studies made by the Southwestern station originated in districts where adequate water and available forage did not continue to go hand in hand, as on well-watered and conservatively managed ranges. In many semi-desert districts cattlemen met with perplexing water-forage problems that developed with grazing. They found that near stock waters the supply of available forage failed, while at the same time there remained large areas of good forage but without available water. With respect to such problems, much more hinges on water than on forage, because stock water is an important factor in determining uniform utilization.

Another factor that came into prominence in complicating the grazing problems particularly on other than mixed-grass ranges, was the perference of livestock for certain kinds of grasses, In the low semi-desert country of western Texas and southern New Mexico, for example, where the ranges are characterized, in general, by black grama areas and tobosa flats, cattle preferred the grama grass, and in many places grazed it beyond its power of recuperation.

Owing to low rainfall, the range lands in the region referred to represent what may be called border-desert conditions. Commonly, permanent waters are few and far between. The mild climate makes possible the use of the ranges throughout the year. The black grama and associated grasses of the higher areas are palatable in all seasons; but the tobosa grass of the flats, which is a coarse bunchgrass, is ordinarily not grazed by cattle if they

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have their choice in the matter, especially when grama is available.

It did not take long under free-range practices for these southwestern grazing grounds to develop a spotted appearence. On poorly watered ranges, areas one mile or more in extent became veritable "dust bowls," where, stripped and grubbed of vegetation of any forage value, even loose sand became a plaything of the winds. A few miles out from water large grama areas with good forage remained practically untouched. And the tobosa flats annually increased their accumulations of dry, unedible growth, which represented what seemed to some observers a waste of much valuable forage.

Needless to say that when grazing resulted in uneven utilization and waste of feed there appeared problems that vitally affected the range industry. As there was no definite knowledge available on which to base even a suggestion of a solution of these problems, the Jornada Experimental Range was created by executive order. This was in 1912.

The range selected for experimental purposes consists of a complete unit of 200,000 acres, and is fairly representative of the low semi-desert grasslands of the Southwest. It is located 23 miles north of Las Cruces, N. M., and is administered as a branch of the Southwestern Forest and Range Experiment Station. The Jornada range is grazed by a privately owned herd of good grade Herefords, used in the production of young range cattle.

In the studies that followed the establishment of this experimental range, three practical objectives were sought: (1) utilization of the coarse tobosa bunchgrass; (2) utilization of those untouched black-grama areas a few miles out from permanent waters; and (3) uniform, conservative, and economic use of forage over the range as a whole.

As is true of practically all coarse bunchgrasses, tobosa is palatable to cattle only during its growing season, when it is succulent and tender. Accordingly, plans were made to graze these flats during the tobosa growing season, and after that graze the grama areas. Such management would amount to practically the same thing as deferred use of the grama areas—that is, the coarse tobosa-grass flats would supply enough forage to keep the cattle off the grama grass until it matured, thus allowing perpetuation of that grass.

Results during first attempts to get proper distribution of the cattle, however, were not fully satisfactory, owing to the fact that, with but few widely scattered waters (wells), large areas of tobosa and grama beyond the

ordinary travel of cattle (about two and one-half miles from water) were never touched or were only lightly used. A solution of this problem was eventually found, but not until salt and water holes were called into special service to aid in getting better distribution of the cattle. In the tests made the stock waters and salt grounds were separated, whereas formerly the salt was usually placed at water.

According to Fred Ares, superintendent of the Jornada range, the results obtained in the tests clearly showed that well-distributed waters (both wells and water holes) and judiciously placed salt grounds away from waters should go hand in hand in range-management plans. Mr. Ares is convinced that, generally, proper salting is highly desirable, for even on ranges that are well watered and have fences to control cattle drift, the careful placing of the salt grounds at some distance from water may aid materially in getting good distribution of the cattle.

Water, of course, is the first consideration. The Jornada Experimental Range has ten deep wells (from 100 to 350 feet deep), nine large earth tanks, and four developed springs. The wells are about five miles apart, and, where possible, are supplemented, at varying distance from them, with the large earth tanks. Theoretically, these waters should have served to distribute the cattle for rather even utilzation of the forage, but it did not work out exactly that way. So long as salt was placed at the waters, the cattle concentrated there; while areas from two and one-half to three miles out were only lightly used, if grazed at all.

When salt was tried to lure cattle away from water, a procedure long known by progressive stockmen and Forest Service officials, the first thing done was to take up all the salt at the waters and to place it at points away from these waters and where the forage needed to be used. On the grama-grass areas the salt grounds were located one to four miles from the waters; and on the tobosa-grass flats, from about one-fourth to one mile distant from the water holes. They were placed closer to water on the flats because on these areas, being smaller than the grama areas, the water holes were constructed rather close together, with a view to assuring proper utilization of the tobosa grass during its growing season.

It did not take long for the cattle to find the new salt grounds. The result was that there was less gathering of the cattle around the water, where before they would not only congregate but hang about. Now they go to water dur-

ing the early part of the day, drink, and soon drift away.

With respect to the salt grounds, the cattle go to them, lick for a short time, and then leave, grazing in all directions. Such movements disprove a common opinion that cattle would alternate between salt and water, with loss of both grazing time and weight, if salt were placed at a distance from water. The outstanding results, over the range as a whole, are much better use of forage on outlying areas and less overuse of the areas close around the watering places.

On the Jornada range, the tobosa flats occur as rather large patches in what is, in general, grama-grass range. The problem here is to keep the cattle off the grama grass during its growing season and to hold them on the tobosa grass while it is growing and usable. Further, it is the aim to hold them on these flats without the construction of any more fences than were on this range when it was acquired for experimental purposes. Water holes and salt were called upon, for the most part, to do the trick.

With the help of CCC labor, 35 small earth tanks were constructed on the tobosa areas. On some flats they were placed not more than a half mile apart. It was thought best to have a large number of these small tanks to assure even distribution of the cattle and also to assure an ample supply of water.

These water holes were located wherever possible, in shallow drainage-ways, and built crescent shaped, with a small embankment (with gradual slope) at the lower side. In some places furrows were run out from the tanks for the purpose of collecting and directing surface run-off to the tanks.

The capacity of these water holes averaged about 58,000 gallons (excavation of about 270 cubic yard), and were constructed at an average cost of $90. Now that such tanks have gone through the experimental stage and it is known how to construct them, they probably can be built for much less. In some places the water sank into the ground within a few days after first filling. To remedy this, salt was placed at these leaky "holes"; and through the trampling of cattle attracted thereby, the bottoms were compacted and hence sealed. After that they held water.

The winter, spring, and early summer months find the Jornada cattle on the grama-grass areas. During the cooler months they may graze out to the most distant salt ground—four miles from water.

Soon after the summer rains come and fill the water holes on the tobosa flats, all salt is taken up from the grama-grass areas and placed on the tobosa flats.

When growth of the tobosa grass starts, the cattle begin to drift of their own accord to the flats, and here they remain so long as the forage is fresh and green—usually through July, August and September, or until proper degree of utilization is obtained. It has been found that tobosa bunchgrass should not be cropped closer than about four inches from the ground, to preserve its vitality. Black grama is easily killed if continually cropped to two inches.

Ordinarily, during July, August and September there is sufficient rainfall and the rains come at such intervals as to keep the tobosa grass fairly fresh, and the tanks supplied with water. Although, during the tobosa growing season, the cattle have access to some of the permanent waters on other parts of the range, both forage and water requirements of the cattle may be fully met on the flats. To aid in holding the cattle on the bunchgrass, some of the permanent waters are closed during this period. When salt is brought into service to aid in getting uniform forage utilization, special care should be given to keep the salt grounds well supplied with salt.

Some cattlemen have raised the question of whether salting away from stock waters would reduce the calf crop, owing to the cattle being so widely scattered. According to Superintendent Ares, no such reduction has occurred on the Jornada range. He is of the opinion, however, that in rough country distribution of cows might necessitate more bulls. But even so, he believes that the benefits resulting from judicious salting would more than offset any additional bull cost.

In viewing the grazing problems on semi-desert grasslands, Mr. Ares feels that the Jornada range-management plans are applicable on similar southwestern ranges. Increased grazing capacity, sustained yields, and preservation of the vegetation around watering places as well as over the range as a whole, he says, should mean much to the cattle industry of the Southwest. Moreover, management that makes possible seasonal grazing of the coarse tobosa bunchgrass and at the same time allows the grama areas and the range as a whole to build up forage reserves will in due time show its value in better herd earnings.

The Tung Oil Industry

Condensed from Better Crops with Plant Food

Ben Hilbun

Agricultural Experiment Station, State College, Mississippi

THE warm soil of south Mississippi that nourished great forests of long-leaf pine trees, now almost gone, may furnish the state another great industry. Tung trees, brought here as an experiment from ancient China, have buoyed hopes of an industry that some think will rival the lumber industry which, after running its course, left thousands of acres of cut-over lands a burden to those who own them.

Grown wild in the great Yangtse Valley of south central China at least 2,838 years B. C., tung trees have been considered, until recent years, as belonging by natural decree to that country. However, in 1907 a few of these trees were brought to the United States for experimental purposes.

A few tung trees were planted at the Poplarville, Miss., Branch Experiment Station in 1927, but little or no attention was given them until 1932. Then Dr. J. C. Robert, director, became interested in the plant that bids fair to revolutionize the agricultural industry in the southern part of the state.

From the beginning of a few trees planted largely through curiosity in 1927, the plantings in Pearl River County have mounted to 50,000 acres, and an expansion program has been launched to add 50,000 acres by the end of 1937, ten years after the first planting. If given reasonable care, by the fifth year a tung tree orchard should produce 1 ton of nuts per acre. The nuts pan out about 25 per cent oil, which sold this year for an average of 15 cents per pound.

Using the cotton crop and tung oil acreages in 1935 as a means of emphasizing the potential importance of tung oil as a cash crop, Dr. Robert compares the $115,000 cotton crop with the 30,000 acres of tung trees. At five years old the tung trees should produce a ton of nuts or 500 pounds of oil per acre, which at 10 cents per pound would amount to $1,500,000.

"The United States in 1935," Dr. Robert said, "used 120,000,000 pounds of tung oil, and produced less than one-half of 1 per cent of that amount. Half of this was produced in Pearl River

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County, showing conclusively that there is a great demand for the product. Present demand, however, is not to be considered the ultimate possibility of the industry, since new uses for tung oil are being discovered, thus adding to the potentialities of this potentially great industry."

Among the 100 or more commercial commodities that contain tung oil are paints, varnishes, lacquers, various water-proof materials, such as oilcloth, umbrellas, linoleum, rubber shoes, brake linings for automobiles and railway equipment, synthetic rubber, and communication equipment. Ashes of tung nuts, from which the oil has been extracted, are used in the manufacture of the so-called India ink. The oil, which dries with a hard finish, is also excellent in protecting objects from weathering processes that normally cause chemical deterioration.

Tung oil has been used in the manufacture of paint for about 50 years. It has been shipped from Japan for about 40 years and for a while was known as Japanese oil. The Japanese obtained it from China and sold it to American consumers under the name which they applied to it.

Perhaps the best known use of tung oil is in the manufacture of spar varnish, which is said to be the only varnish that will not turn white when water is placed in it. This varnish is made of tung oil and resin. South Mississippi, site of the greatest development of tung trees in America, grows both pine trees and tung oil. The two in many instances are growing side by side, bringing together two useful products that were produced on separate continents for many centuries.

The largest tung oil project in the world is located near Picayune in Pearl River County. It embraces slightly less than 10,000 acres and is owned by Lamont Rowland, who is utilizing cut-over land in an extensive development.

Tung trees, according to Dr. Robert, require a heavy rainfall —about 60 inches annually— and do not thrive where the temperature dips lower than 12 degrees. The rainfall and temperature of the lower third of Mississippi compare favorably with that of the tung tree section of China. The soil, he thinks, is excellent, although tung trees, like any other plant, are affected by the amount and kinds of plant food in the soil.

Some experimental data on the effects of commercial fertilizer in varying amounts on tung oil productions have been gathered from tests conducted by the Great Southern Lumber Company of Bogalusa, Louisiana, which has extensive plantings on average cut-over land. Superphosphate

(18 per cent) used alone in varying amounts, muriate of potash used similarly, and a complete fertilizer were tested against a check plot of no fertilizer.

Yields on the six plots of 1 acre each were varied, showing a decided leaning to the use of fertilizer in the production of tung oil. The yield on the 1-acre plot that was treated with 100 pounds of 18 per cent superphosphate was 1,327.5 pounds of nuts as compared to 1,405.61 pounds from the acre receiving 200 pounds of the same fertilizer.

An application of 200 pounds of muriate of potash used alone gave a yield of 1,030 pounds of nuts per acre and a combination of 200 pounds of 18 per cent superphosphate and 100 pounds of muriate of potash boosted the per acre yield to 1,617 pounds of nuts. A complete fertilizer, 4-14-10, applied at the rate of 200 pounds per acre gave a yield of 1,317 pounds of nuts.

Checked against the fertilized plots was an acre of the same age trees on the same type soil and handled with the same care which, relying wholly on the original fertility of the soil, produced only 755 pounds of nuts.

Research in horticulture at the Louisiana State Experiment Station has resulted in tentative recommendation of a 4-8-4 fertilizer for tung oil trees, applied at the rate of 1 pound per year of age of tree until the tree is 4 years old. Like the Poplarville Experiment Station in Mississippi, they recommend the use of legumes, such as soybeans, cowpeas, and crotalaria.

Summer and winter legumes have been grown to determine the value of cover crops alone as soil-improvement agents. All have proven beneficial, but the cover crops are being varied in an effort to determine which are giving the best results. "The object," Dr. Robert says, "is to increase the humus content of the soil and the nitrogen turn-over for the tung trees. Check plots, which were not planted to legumes, produced 306 pounds of nuts per acre from trees planted in 1932. On the plots where legumes were grown, 700 pounds of nuts per acre were harvested."

Trees, it is found, grow and produce more satisfactorily when cultivated. Shallow cultivation at intervals of 6 to 8 weeks, depending on the vegetation, reveals a marked increase in growth and production over uncultivated plots.

Tung trees, like any other crop, are affected in growth and production by the quality of the soil. Poor land, minus the necessary plant food, will not produce tung trees profitably.

Good soil and the proper treatment of young and old trees are essential in a profitable venture

in the production of tung oil.

Care should be exercised in planting tung trees. They should not be spaced closer than 25 to 30 feet on an equilateral triangle basis. Trees spaced 30 feet apart in this manner would give about 50 per acre, and 25 feet apart, 70 per acre. Since these trees live and grow for a half century or more, if properly handled, ample space should be allowed for them to expand. One 30 years old, is 41 feet tall, has a limb spread of 40 feet, and measures 72 inches in circumference 1 foot above the ground.

It has been found advisable in transplanting tung trees to leave all roots possible. The tap root should be not less than 15 to 18 inches long, and the holes for planting 2 to 3 feet square and 2 feet deep. A few shovels of stable manure or decayed vegetable matter mixed with top soil and placed in the bottom of the hole, the top soil carefully sifted between the lateral roots, and 1½ to 2 gallons of water siphoned around the tree are helpful in getting the young trees away to a good start. A little grass, straw, leaves, or other vegetable matter spread around the tree will aid in keeping the soil moist, and in eliminating baking and hardening.

Young seedlings, as a rule, should be cut back to within 6 or 8 inches of the ground, and only one bud—the strongest one nearest the ground—should be left, allowing only one body from the roots, which will branch from 3 to 5 feet from the ground. One-year old seedlings are normally better than 2-year old ones which require more careful handling than the younger ones.

The two major problems of all cash crops, economic production and profitable marketing apply to tung trees. However, profitable marketing, as far as tung oil is concerned, is solved for many years, in the opinion of Dr. Robert, since the amount of tung oil used is now limited by the amount available. Present use of this oil, if supplied by the American market, would require from 400,000 to 500,000 acres of trees. In addition the United States annually imports linseed oil, which is inferior to tung oil for paint purposes, and it would require a minimum of 300,000 acres to supplant these imports. Moreover, new uses for tung oil are constantly being discovered by manufacturers, thus opening up new potential demands for the product.

Rammed Earth for Economy

Condensed from The Dakota Farmer

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RAMMED earth walls are both warm and fireproof—a combination that is difficult and expensive to secure in any other material.

In the rammed earth poultry house at the South Dakota State College the early morning temperature averaged 5.9° F. warmer for three successive winters, than in a duplicate frame house.

Building walls of rammed earth is not a difficult job, especially for buildings such as poultry houses, hog houses, milk houses, and other single-story buildings. After one has had experience building one of these single-story buildings, he will have no trouble in building the larger and more complicated ones. Rammed earth walls are made by ramming moist dirt into a section of short, heavy form. The dirt used is only moist. It is not in any way a mud, such as is used in making adobe bricks. The form is used like a form for building concrete walls except that only a short section of form is used. The form is set up and a section of wall is rammed in it. The form is then immediately taken down, moved ahead on the foundation, and another section of wall is rammed. The ramming is done by hand. It can be done by mechanical power, but hand ramming is not difficult.

In making rammed earth walls, the first thing is to find out how the soil is. It may be an excellent soil just as it is, or it may be a medium soil that could easily be made an excellent soil, or it may be a soil that is unfit to use for this purpose. Of some 35 different soils that have been collected and used from all parts of South Dakota, 7 or 8 have been excellent soils just as they were dug up, 4 have been unfit to use, and the other 24 range in between. Most of these 24 soils are easily made into excellent soils for the purpose by adding sand, and most all the work on buildings has been done with soil that is only medium in quality. When an extra good wall is wanted, a little sand is mixed with the dirt to make it an excellent soil for building. The Experiment Station has discovered and developed a method of testing a soil in the

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laboratory that will not only tell whether the soil is fit to use or not, but will tell just exactly how favorable it is. However, a simple test can be made at home that usually will be satisfactory.

In making this test, a flat pan, 3to 4 inches deep, is all that is necessary. In getting the sample of soil it is important to get one that is a fair and representative sample of the dirt that is to be used. More than a quart of dirt should be taken in this sample, and the clods should be crushed. Pebbles should be left in the sample, just as they come. This sample of soil should be placed in an oven that is reasonably hot for a period of three to four hours and thoroughly dried.

A quart of dirt should then be emptied into the clean pan and covered with water to a depth of 2 inches or so. Using the hand, this dirt is then stirred around in the pan rather carefully, and from time to time a part of the dirty water is poured off and fresh water is added. A little care should be used in this process as it is possible to pour off some of the very fine sand. In a half to three-fourths of an hour's time and after many changes of the water, the water will become clear, which means that all the clay and silt is washed out and nothing remains but clean sand and pebbles. The pan should then be set in a drying oven again until the sand is dry; after which it should be measured in a kitchen measuring cup. If there is a full cup of sand left in the pan, the soil will contain about 30% of sand by weight and is apt to be satisfactory for rammed earth walls. If there is more than a cup of sand, the soil will be still better, and if there are three cups of sand, the soil will be excellent. This test will be reliable in three-fourths of the cases, probably—but there are exceptions in which soils containing even less than one cup of sand have proved to be excellent soils.

Concrete is the best material for the foundation of the wall, and the top of it must be as wide as the thickness of the wall that is to be built. The thickness of earth walls may vary from 12 to 14 inches for low walls, to 24 inches or more for very high walls. Walls of 12 to 14 inches in width should not be used for heights of more than about 8 feet.

The forms for making the walls are the same regardless of the thickness of the wall to be built, except in the length of the bolts that must be used. The forms are heavy. They are built of 2-inch material and are held together by bolts and 4x4-inch staybraces while in use. The forms should be built to fit around a corner of the building, and should extend 8 or 10 feet each way. On straight walls, they can be straightened

up, the inside is brushed lightly out in one long form or used as two short forms.

Just before the forms are set with used crank-case oil. This keeps the forms from sticking to the wall when they are removed. When the forms are set up, they rest on the foundation or on top of the under section of wall on the bottom row of bolts. Before they are tightened up they should be leveled with a carpenter's level, and short 2x2-inch spacers are put in under the top bolts before they are tightened.

The loose dirt is shoveled into the form in layers 4½ to 5 inches deep for each layer. When this is leveled off and rammed solid, it will make a layer of hard wall about 2 to 2½ inches thick. This varies a little bit with the kind of dirt that is being used. Sandy soil will ram into a thinner layer and it also rams solid more quickly than the others, so if sand or bank-run gravel is added to the dirt, time and work will be saved. If the work is stopped and the top allowed to dry out, it is a good practice to wet it down before continuing the ramming. After the form is filled to within 6 or 8 inches of the top, the wing-nuts on the bolts are loosened and removed and bolts withdrawn. The form is then moved ahead and set up for another filling.

The end gates or end pieces for the forms do not slide into a groove as is the case with the wagon bed, nor are they always set at the extreme end of the form. These end gates are set into the form at any desired point by nailing a temporary strip on each side to hold them. This makes it possible to break joints in the wall from the section of wall below and to leave openings for doors and windows exactly where desired. Sharp corners on the outside of buildings are not desirable, so corners are beveled. This is done by placing a little strip in the form about the size of a quarter-round, except that it should be sawed flat. Window frames should be of 2-inch plank. They are set into the forms and the wall is rammed around them. To make the joints weatherproof, a 2x2-inch strip nailed on the outside of the frames will make a tight joint if the earth is rammed around them. Plank braces are fitted into the window frames while the wall is being rammed, to prevent the springing of the sides. Lintels over windows and door openings can be made by putting in an extra plank over this frame, or steel reinforcing rods can be used over the openings. When ramming over windows and doors, vertical plank braces are set into the frames to prevent springing of the top. Two-inch planks are used for plates on top of rammed earth walls. They should not be less than 8

inches wide. These plates are anchored to the wall in the same way that sills are anchored to a concrete foundation, except that the bolts must be longer. The bolts should be embedded in the wall as deep as the wall is thick. At the head of the bolt which is embedded in the wall, a large iron anchor washer should be used. These bolts must be set into the form while the top section of wall is being rammed, and then the earth wall is rammed around them. They should extend above the wall far enough so as to allow for bolting down the plank plate on top, and an ordinary heavy washer should be used under the nut of the bolt.

After the walls are rammed and this anchor plate installed around the top, the roof is built exactly the same as it would be built for an ordinary frame building. In order to level up the plate it is a good idea to spread a thin layer of mortar on top of the wall, as it is impossible to ram the wall perfectly level and smooth.

Hand rammers are the only special tools required in building these walls. The rammer head should be of metal. A flat face on the rammer head seems to be most satisfactory, and there are two sizes that seem to be best. One rammer which can be bought at any hardware store is called a floor-rammer. It has a metal head that is about 6 inches square, with a wooden shaft or handle. These rammers weigh about 25 pounds and they are satisfactory for going over the loose layer of dirt the first time. A smaller rammer is better for finishing, although it can be used for the entire layer. This rammer should weigh 16 to 18 pounds and it should have a face about 4 inches square or a little less.

It is important to have the right amount of moisture in the soil when the wall is rammed, just enough to pack well. In adding moisture to the soil, it will be found that some soils will take twice as much water as others in order to contain the right amount of moisture.

In starting the work, the moisture in the soil may be tested by pressing a handful of it in the hand and dropping it onto a hard floor. The earth should stick together in the hand, but when it strikes the floor it should break into pieces. It is better to have it too wet than too dry.

After a roof is put on a rammed earth building, the walls will stand up to the most severe weather conditions. The eave projection does not necessarily need to be any wider for these walls than for any other type of building. In fact, they could even be less, but there must be an eave. When heavy rain falls on top of an earth wall while it is being built,

it will run down the face of the wall and in time will cut like a knife. For this reason, the tops of the walls must be protected at all times during construction. Almost any material could be used for this purpose, but tough Sisalkraft paper or strips of old prepared roofing make the handiest protection.

After the walls are finished, the bolt holes are left through the walls. These bolt holes are very easily rammed full of earth, or better, a lean mixture of ¼ mortar. They should be rammed completely full and from both sides. The joints between sections of wall rammed, may open up a little bit, especially if the soil is not very sandy. These joints are rammed full in the same way, because after the wall shrinks the first time the joints will not bother.

Earth walls can be plastered directly on the surface quite satisfactorily. The first coat of ordinary plaster is put on and nailed with 10-d. nails at once, while it is fresh. The second coat is then put on the same as for any plastered wall.

Kentish Clover

ON the broad meadowlands of Kent, in Southern England, a strain of clover has been developed which is known as Kentish Wild White Clover.

Its recent introduction into America has aroused considerable interest and it will undoubtedly prove to be a very valuable addition to pasture mixtures throughout the Northeastern section of the country. As it is considered superior to the commonly grown White Dutch Clover it is probable that it may gradually replace this in most pasture seedings.

Kentish Wild White Clover is extremely prostrate in habit and produces a dense sward. It spreads rapidly and on the Romney Marsh, where it is indigenous, one plant, after several years of growth, will cover from four to five square yards. The procumbent stems send out roots from every node, making an elaborate and very dense root system. It is extremely persistant and has the ability to withstand heavy grazing. When closely mowed or grazed it continues to produce a constant succession of small leaves and it supplies a large amount of digestible food material per acre. In some sections of Kent it is not uncommon to find that this strain of wild clover, in combination with other grasses, will maintain from twelve to fifteen sheep per acre throughout the long grazing season.

Because of its deep and elaborate root system it is comparatively drought resistant and it is well adapted to a wide range of soil and climate. Although it prefers a limestone soil it is more tolerant of acidity than many other legumes.

During the past few years Kentish Wild White Clover has been used in pasture seedings at Cornell University with excellent results. It has been sown at the rate of one pound per acre in combination with various pasture grasses.

In England it has been found necessary to observe certain points in pasture management in order to preserve a balance between the clover and the grasses when they are grown in association. Close grazing and continuous mowing encourage a vigorous growth of clover and in order to prevent it from becoming overdominant it is sometimes necessary to delay grazing until the grasses have had an opportunity to make sufficient growth. A heavy application of nitrogen will also stimulate the growth of the grasses at the expense of the clover.

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